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REACTOR SAFETY ISSUES AT DEPARTMENT OF ENERGY FACILITIES

HEARING

BEFORE THE

COMMITTEE ON GOVERNMENTAL AFFAIRS UNITED STATES SENATE

ONE HUNDREDTH CONGRESS

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REACTOR SAFETY ISSUES AT DEPARTMENT OF ENERGY FACILITIES

THURSDAY, MARCH 12, 1987

U.S. SENATE,
COMMITTEE ON GOVERNMENTAL AFFAIRS,
Washington, DC.

The Committee met, pursuant to notice, at 9:40 a.m. in room SD-342, Dirksen Senate Office Building, Hon. John Glenn, Chairman of the Committee, presiding.

Present: Senators Glenn, Cohen, Roth, and Heinz.

Also present: Senator Adams.

OPENING STATEMENT OF CHAIRMAN GLENN

Chairman GLENN. The hearing will be in order.

Today, we begin the first of two hearings on environment, safety, and health conditions at the Department of Energy's nuclear weapons production facilities. My personal interest in this issue goes back quite a number of years and was focused very much in the late 1970's when I became aware of health and safety problems at the Portsmouth nuclear enrichment plant in Piketon, Ohio.

A few years after that at the end of 1984, I began receiving reports about environmental contamination resulting from releases of uranium oxide through the stacks at the Feed Materials Production Center in Fernald, Ohio. A preliminary examination of this problem by my staff raised concerns that the problems at Fernald were a result of administrative neglect by the Department of Energy that might be system-wide.

I asked the General Accounting Office to do a series of studies for me which has resulted in reports showing that those concerns were not unfounded. I think we have five direct reports, as well as I think there are 17 or 18 other ones that you have done for other people that we have been connected with in one way or another, but five direct reports from me that started out on Fernald and the last one, then, went across the board as far as the production of nuclear material goes, across the board and across this country.

Now, I am as anxious as anyone to be sure that the United States can meet its national security obligations and build whatever weapons are needed in order to deter potential aggressors. But it will do us precious little good to protect ourselves from the Soviets or any other potential aggressor if, in the process, we poison or substantially irradiate our own people.

The main focus of today's hearing will be on the safety of the production reactors that the Department of Energy uses to produce plutonium and tritium for nuclear weapons. These reactors are located in the State of Washington at the Hanford facility and in the State of South Carolina at the Savannah River facility.

The testimony we shall hear today will indicate that despite actions taken by the Department of Energy to improve nuclear safety at these sites, there are significant questions still remaining that suggest the steps being taken by the Department are not enough. Chernobyl has taught us what can happen as a result of a nuclear accident. We cannot let that happen here.

I have asked the General Accounting Office to provide two different sets of testimony at today's hearings. We will first receive a general overview of the environment, safety, and health issues at the DOE nuclear weapons complex, and then we shall receive testimony from the GAO and other witnesses specifically on reactor safety issues.

Senator Cohen, do you have any comments?

OPENING STATEMENT OF SENATOR COHEN

Senator **Cohen**. Mr. Chairman, I want to commend you for holding the hearings and simply add my words of support for what you have said. I think you and I have a unique opportunity to serve on the Armed Services Committee as a well as this Committee.

I want to reassure those here that indeed you have been very supportive of maintaining a strong nuclear deterrent capability. But as you pointed out, equal to that capability must be the safety requirements to protect our own people, and some of the reports I have heard have been very disturbing indeed about the lack of safety precautions for the reactors.

I would yield my time to the Senator from Washington, who might talk at some length about the problem in his backyard.

Chairman **Glenn**. Thank you, and I know of Senator Cohen's personal interest in this. As long as he has been in the Senate, we have been working together on some of these matters and he is a person who shares my concerns about this. We have mutually worked on this and plan to continue to do so into the future.

Sitting in with the Committee today but not a Committee member, per se, is Senator Brock Adams. He was a U.S. attorney, going back some years, and then was a Congressman, was Secretary of Transportation, and is particularly interested in this matter, since the Hanford site sits in the State of Washington that he represents.

So the only caveat we would put on his appearance this morning here is that as our own Committee members show up here, we have to give them priority on questioning. Outside of that, we welcome you as a full-fledged participating member here today.

So, Brock, any remarks you might want to make.

OPENING STATEMENT OF SENATOR ADAMS

Senator **Adams**. Thank you very much, Mr. Chairman. First, I want to thank you for your courtesy, and Senator Cohen, for inviting me and giving me the privilege to be here this morning.

We have an enormous concern in our State, and I want to commend you for your remarks, Mr. Chairman, because all of us are concerned about maintaining the security of the United States, and I think what is most upsetting to those of us who are in the States that have major facilities, such as the facilities that we have at Hanford, Washington, is becoming aware more and more every day of the dangers to both public health and to the environment from an outmoded system.

The system has been shrouded in such secrecy that we have not known whether these production facilities were adequate, whether they were up to date, whether they had been modernized.

We are now in a position where, due to certain reports that the Chairman and other members of this Committee were really responsible in many ways for seeing occur, that reactor has been shut down. It is about to be reopened within the course of this year.

We do not know the degree to which there will be an environmental impact statement. It is not up to the standards of civilian reactors. We do not know whether or not the changes that will be made to it will be such that we will have a facility for the future.

And I think, Mr. Chairman, what bothers us most of all is I do not know of anyone who does not say that the reactors at both Savannah River and at Hanford are old; they probably have to be replaced. At Hanford, they certainly will need to be replaced, in that it happens to be a graphite core reactor that will swell to its containment vessel some time in the early 1990's.

I have some familiarity with this reactor, in that I tried lawsuits on it when it was being built, and that is over 20 years ago. It was a problem then, and I am looking forward to the testimony this morning, Mr. Chairman, so that I get some idea of whether or not improvements have been made, whether there are criteria for reopening it, whether there is a plan for phasing it out or creating a new facility, if one is needed for national security purposes, and the only way we can do this is through the oversight process.

So, John, I want to thank you very much for allowing me to be here and I look forward to the testimony.

Chairman GLENN. Thank you. Welcome to the Committee.

The first witness this morning is J. Dexter Peach, Assistant Comptroller General of the U.S. General Accounting Office, accompanied by Keith Fultz, Associate Director of the U.S. General Accounting Office.

Mr. Peach, we welcome your testimony either in full or a summary thereof and, in any event, the full testimony will be included in the Committee record.

TESTIMONY OF J. DEXTER PEACH, ASSISTANT COMPTROLLER GENERAL, U.S. GENERAL ACCOUNTING OFFICE,[1] ACCOMPANIED BY KEITH O. FULTZ, ASSOCIATE DIRECTOR, GAO,[2] AND MS. GARY JONES, EVALUATOR, GAO

Mr. PEACH. Thank you, Mr. Chairman. My purpose today is to try to provide an overview of what exists out there in the nuclear defense complex, and then my colleague, Mr. Fultz, will be presenting a separate statement dealing with work we are currently doing for you at the Savannah River complex with respect to reactor safety issues.

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[1] See p. 61 for Mr. Peach's prepared statement and attachment.

[2] See p. 78 for Mr. Fultz's prepared statement.

The reports that we have issued over the years, some 20 reports, have described a variety of unresolved safety and environmental problems at DOE's nuclear defense facilities, but when considered together, they underlie a series of critical issues that the Congress and the Administration need to face in determining the future of the DOE nuclear weapons complex.

I think it is the collective issue that the Committee needs to begin addressing, as well as the individual problems. These issues arise from three factors. One, the facilities are old and some are already operating beyond their expected life. Unresolved concerns exist about the operational safety of many of the facilities and there has been a lack of attention to environmental problems created by facility operations over the years that has lead to undefined backlog of clean-up actions needed.

The cost of remodeling or rebuilding new facilities will be in the billions, as will the cost of bringing the facilities into compliance with environmental laws.

What the Congress needs from DOE now is an overall strategic plan which defines the universe of problems it faces in rebuilding its nuclear defense complex. This strategy should include not only actions needed to rebuild or upgrade facilities with time frame and cost estimates, but also actions needed to protect the environment and assure the Congress and the public of DOE's safe operation.

Now, let me briefly just try to take this apart, summarizing from my statement some of the safety factors, some of the environmental factors, some of the cost factors that we have identified from our work.

Our work on safety matters at DOE facilities over the last several years has included Hanford, Savannah River, and Rocky Flats, and has identified important safety issues which, considering their scope, raise serious questions about both the safety of individual facilities and DOE operations as a whole.

Very recently, in June 1986, we reported to you on DOE's safety analysis reports for eight of DOE's operating facilities. Our review showed that some safety reviews have not been approved by DOE, some provided little or no comparison with safety design criteria, and different assumptions were used in analyzing serious accidents.

We also pointed out that the safety review process is the internal DOE function carried out primarily by DOE field offices to assure the adequacy and safe operations of these facilities.

But the GAO has a much longer history of recommending both internal and external improvements in safety oversight of DOE's defense production activities. In 1981, we pointed out that one of the basic underlying causes or shortcomings in safety programs was its structure within DOE.

We argued for a separate office within DOE specifically set up to oversee safety matters and reporting to the under secretary. DOE originally disagreed with our recommendation and it was not until September 1985, under Secretary Herrington, that it established an Office of Assistant Secretary for Environment, Safety, and Health, an action which we do believe, in effect, adopted that 1981 recommendation.

But in that 1981 report, and again in our 1986 report, we highlighted the need for outside independent reviews of safety analysis reports. DOE has been less responsive to this recommendation.

DOE has stated that its own Office of Assistant Secretary for Environment, Safety, and Health now provides sufficient independent review. DOE's position on this matter, from our point of view, is difficult to understand and could be viewed as inconsistent because DOE, on occasion, does use outside independent reviews.

For example, when faced with safety concerns about the N Reactor because of its design similarity to the Chernobyl reactor, DOE sought outside help from a group of experts, the Roddis Panel, and DOE has requested the National Academy of Sciences to review other DOE reactors, including production reactors at Savannah River.

DOE's reluctance to establish a continuing mechanism for outside independent review carries with it important implications. First, there will be no outside independent scrutiny on a continuing basis. This places reliance on DOE's information and views for ensuring safety, which may not be the same as an outside group's. The Roddis Panel demonstrated this difference in their report, and its views led to accelerating safety work at the N Reactor.

Another implication is possible conflicts between production goals and safety functions. Conflicts can and do occur. The situation at the Fernald plant in Ohio demonstrates this problem.

During the 1970's, DOE considered closing this plant. As a result, it did not make capital improvements and equipment became obsolete. In the 1980's, production goals increased, putting a strain on the plant's resources. According to DOE's own documents, Fernald management emphasized production over worker safety and health concerns.

We continue to believe that outside independent oversight is critical if DOE wants to provide a high degree of public assurance that its operations are safe and conducted in an environmentally acceptable manner.

We are aware that you are proposing legislation that would have an outside group review and evaluate DOE's nuclear facilities, and the hearings you are conducting today should provide an excellent opportunity to hear testimony on the proposal and to explore with DOE officials the reasons why they believe outside oversight is not necessary.

Besides the safety issues, we have also dealt with important environmental problems needing corrective action which could have long-lasting effect on the environment and pose a health threat to the general public.

In a September 1986 report, we reported that DOE operations had contaminated groundwater at eight of the nine facilities reviewed. In many cases, the contamination included both hazardous and radioactive material and was at levels hundreds to thousands of times greater than drinking water standards.

We also found that four of the nine facilities were not in full compliance with the Clean Water Act, and none had final permits for disposing of waste under the Resource Conservation and Recovery Act.

As a result, at some facilities DOE is discharging waste into rivers and streams above State limits and is continuing to dispose of waste in a manner that adds to groundwater contamination.

In addition, we found that Hanford had been slow to identify all units that should be regulated under the Resources Conservation and Recovery Act, and it had not identified all waste sites that may require corrective actions.

Specific GAO recommendations on environment include that DOE develop an overall groundwater and soil protection strategy and provide the Congress a comprehensive report on its plans, milestones, and cost estimates for bringing its facilities into compliance with applicable environmental laws.

We have also recommended that DOE allow outside independent inspections of the disposal practices used for any waste it now self-regulates. DOE has not yet decided on outside independent inspections of waste disposal because of an ongoing study. We hope one result of this ongoing study will be to allow outside independent inspections of DOE disposal practices, as we recommended.

The cost of dealing with the safety and environmental problems will be substantial. In some cases, the total cost is speculative because the solutions to problems have not come before the Congress.

To provide some perspective, let me just highlight a few cost estimates. Currently, a $50 million safety upgrade program is underway at the N Reactor. If the N Reactor is to continue operating beyond the early 1990's, major renovations costing as much as $1.2 billion will be needed.

A new production reactor which DOE is considering could also cost billions, even if DOE modifies and finishes construction of the partially completed commercial nuclear reactor owned by the Washington Public Power Supply System.

Repairing building 371 at the Rocky Flats plant could cost about $450 million. If DOE decides to move the entire Rocky Flats plant operation for safety reasons, that move could cost billions of dollars.

As for environmental problems, at three facilities we went to—Fernald and Mound in Ohio, and Y-12 in Tennessee—DOE plans to spend over $60 million to bring them into full compliance with the Clean Water Act.

To get final permits at the nine facilities we reviewed, DOE is changing its disposal operations, at a possible cost of $200 million. The eventual cost could be much higher, depending on how site-specific environmental problems are resolved. For example, groundwater clean-up could easily amount to hundreds of millions of dollars at a single site.

As I indicated at the outset of my testimony, and let me conclude by emphasizing, DOE needs an overall strategic plan that sets forth the projected facility requirements for continued nuclear weapon production, a comprehensive picture of the environmental, safety and health issues facing DOE, and solutions to resolve them.

The plan should provide a comprehensive picture of what DOE's nuclear defense complex will look like in the year 2000 and beyond, and provide a road map of how we get from here to there.

Some of the broader issues that need to be addressed in this plan are: what are the facility requirements for continued operation of DOE's nuclear defense complex; what is the full scope and extent of environmental and safety issues facing DOE; what actions will DOE take to ensure its facilities are operating in a safe manner; to what extent will DOE develop a groundwater and soil protection strategy and clean up contamination at its facilities. Of course, the strategy should address the resolution of these questions, time frames, and total implementation costs.

Once the strategy is presented to Congress, it will be useful in making effective legislative and budgetary decisions. Without such a plan, piecemeal solutions to issues and problems will occur as they have in the past.

Mr. Chairman, the issues and problems we have identified in this overview are significant and require action. For that reason, we have today forwarded a copy of this testimony to the Secretary of Energy, along with our recommendation that he initiate action on the overall strategy for the DOE nuclear defense program.

That concludes my summary, Mr. Chairman, and we would be pleased to try to answer your questions.

Chairman GLENN. Thank you very much, and we will have questions of you before we go on to Mr. Fultz here.

We have our ranking minority member, Senator Roth, who is here. Bill, do you have any comment you wanted to make before we get to questions here?

Senator ROTH. Thank you, Mr. Chairman. I do have some opening remarks, but I will include them without being read.

Chairman GLENN. Fine. We will include them in their entirety in the record.

[An opening statement by Senator Roth and an opening statement by Senator Heinz follows:]

OPENING STATEMENT OF SENATOR ROTH

Mr. Chairman, I would like to take this opportunity to thank you for arranging this set of hearings on the status of nuclear reactor safety issues at Department of Energy facilities.

The three recent hearings that we have held on nuclear non-proliferation issues, while separate from these hearings and questions, stir similar emotions and concerns. Nuclear materials, whether we are discussing nuclear energy or weapons grade plutonium, must always be treated with the utmost care, security, and safety.

Last year, the world witnessed the biggest nuclear accident in the history of mankind. The Chernobyl nuclear catastrophe reminds us of the importance of sound safety requirements and reviews. In light of the Chernobyl accident, the Department of Energy carried out an extensive internal review of its "N-reactor" in Hanford, Washington.

In addition, the Secretary of the Department, John Herrington, requested that six independent consultants, known for their knowledge of nuclear reactor facilities, undertake reviews of the Hanford site. These reviews have been completed, and I understand the Department has taken into consideration the more than 100 recommendations resulting from these various studies.

I am pleased that the Department decided to take steps forward towards a comprehensive review of the Hanford facility. As a result, the facility is currently shut down for a six month period, undergoing $50 million in safety repair work. I look forward to receiving the General Accounting Office's testimony today concerning this facility, as well as the Department's Savannah River facility.

Nuclear safety issues, whether they involve commercial operations or Government facilites, are extremely important. We owe it to the public that Government facilities meet the high standards of reactor and environemental safety, and pose no threat to the welfare of the American people.

A critical element of maintaining safe facilities is maintaining a system of sound safety reviews and checks. The Department of Energy Office of Environment, Safety, and Health is a strong, vital component of this system. Whether an additional review committee or advisory panel is needed is a question to be addressed by these hearings. I am hopeful we will explore the delicate balance between ensuring both the highest standards of unclear safety and satisfying the national security requirements or our Nation.

I look forward to today's testimony and continued hearings on the safety and environmental questions surrounding the energy department's nuclear facilities.

OPENING STATEMENT OF SENATOR HEINZ

Mr. Chairman, I want to commend you for calling this hearing on reactor safety issues. I have more than a parochial interest in this subject. The Three Mile Island accident in Harrisburg, Pennsylvania, raised serious questions regarding the release of extremely hazardous radioactive materials, and safety planning at nuclear reactors generally. These questions are inherent in all nuclear products, whether the commercial generation of power from reactors, or the development of weapons-grade materials.

I understand that today's testimony will raise serious concerns regarding the safety of nuclear production at the Hanford, Washington, and Savannah River, South Carolina reactors. Given the potential hazards, we must demand a high standard of safety of all nuclear production facilities, both commercial and Federal. The 1950s-era technology at the Hanford facility, the use of the graphite stack—which is similar to Chernobyl-4's reactor core—and the unique design of the "N" reactor generally cause me great concern. We cannot accept undue risk at the Hanford site, nor can we accept the additional risk of weakening our national security by halting weapons—grade nuclear production all together. Mr. Chairman, we are truly on the horns of a dilemma.

Corrective action on the confinement seals has not been undertaken at Hanford. At the same time, Mr. Roddis' report, which I have, states that Hanford's graphite stack is growing and will be in contact with the thermal shield in the not-too-distant future. Mr. Roddis' report indicates that Hanford is operating at a degree of risk that would not be acceptable in a commercial reactor.

The questions which I hope this hearing will answer are: do most of the 8 other reviews of Hanford back Mr. Roddis' analysis? What options do we have to continue producing sufficient weapons-grade materials to safeguard our national security, while taking remedial action at Hanford and Savannah River? While I look forward to reviewing the testimony to be presented today, and I will take no pleasure in weighin the many risks this situation presents us.

Chairman GLENN. We will go by our ten-minute rule and the early-bird rule, as we follow on the Committee, also.

Let me ask first do we have any estimate of what the overall cost of putting our whole nuclear production facility into first-class condition and in compliance with all the environmental laws. Do we have an overall estimate of what it will cost to do this whole job?

I was just totaling up figures that you tossed out very rapidly: the N Reactor out at Hanford, $1.2 billion to do whatever needs to be done to that or to replace it, or whatever; $450 million, Rocky Flats; $60 million at Fernald and Mound; $200 million for disposal clean-up.

We did not address a dollar figure to clean up groundwater contamination and things like that. All at once, we are up here into the $2.5 to $3 billion area, and we have not even gotten to some of the clean-up costs.

Has anyone gone through yet, or will the Department of Energy study give us a figure to do the whole job that needs to be done to make this whole thing safe and still have the production that we need for this country? Is that a figure that we can start considering, because it looks to me like it is going to be in the billions?

That is a big, long-term question here. Maybe you want to break it down into parts of clean-up and production.

Mr. PEACH. I think that would be a good way to approach it, Mr. Chairman. The easy and quick answer is that kind of information is not available. That is a part of what we are calling for in saying you really need to have a road map and strategic plan for what you need to do and how you want to get there.

Now, in the environment area, for example, the best we can say is we think the cost is going to be in the billions, but how much will depend on the extent of actions you have to take to clean up things like the groundwater and soil contamination, and also how far you want to go in clean-up.

There is an issue there, for example, with some of these facilities as to whether you will have to consider that they are going to be seriously contaminated and will require long-term care in the future.

Chairman GLENN. Okay. Now, we insist in other activities that deal with nuclear power, nuclear electrical generating plants, and so on—we have certain standards considered to be safe for the communities with regard to groundwater, air, everything surrounding that plant.

Now, it seems to me if we have established certain standards as being protective of the health and safety of the people around those plants, we could do no less at the plants that are in the military production cycle run by DOE.

Now, do we have any estimate of dollar figures as to what is going to be required in this area?

Mr. PEACH. No, we do not in the environmental area, and when you move over to the safety side, the figures I have cited are substantial. But as you move into issues of whether you are going to build new reactors or not, then you are probably talking about even more substantial costs.

Modifying the N Reactor, if you can modify it, DOE estimates will cost $1.2 billion. If you move to try to either modify this Washington Public Power Supply System reactor that is down or build some other new reactor, I would expect you are looking at more substantial cost by billions than that $1.2 billion figure.

Chairman GLENN. You tossed a figure in the early part of your testimony there that we have an investment in these facilities of somewhere around $100 billion or more, and I presume those are costs back in days past.

Mr. PEACH. That is correct, sir.

Chairman GLENN. Do we have any estimate yet of what portion of the overall system needs to be replaced, just so we get some idea of what the dollars involved are?

Mr. PEACH. I do not have an estimate, and I think one of the places where DOE needs to start is in developing that kind of estimate. I think this is one of those areas where you could refer to a possible huge future expenditures coming in because of problems that have developed over the years that we are not dealing with at this time.

Chairman GLENN. Describe the type of oversight that you think appropriate for DOE, including who should do it and the scope of the facilities covered.

Mr. **Peach**. Okay. Our view is that there should be independent oversight from outside DOE by some panel of people distinguished and technically knowledgeable in nuclear issues that could come in and review at least the safety analysis review process and other major aspects of the operations to provide an outside assurance that they are safe operations.

We see the Assistant Secretary for Environment, Health, and Safety within DOE as being a part of a checks and balances system within DOE to assure that everything is operating properly. But a purpose of this outside review would be to make certain that this checks and balances system even within DOE is working to assure safe operation.

Chairman **Glenn**. That is a fairly new office. When was that established?

Mr. **Peach**. It was established in 1985.

Chairman **Glenn**. All right. Now, has it been in operation long enough so that we can make an assessment as to their effectiveness?

Mr. **Peach**. I do not think you could make an overall assessment. There are some positive indications with some things that are happening. If I were to give you a sort of a report card of where DOE stands right now, I would say creating that office was a positive step. We had recommended something like that and DOE had resisted that for four or five years.

I think Secretary Herrington took a more positive attitude towards being more active in trying to deal with safety and environmental problems, and I think as we have made recommendations on trying to identify the scope of environmental problems, trying to get the safety analysis reviews up to date, they have been active in trying to take actions on those recommendations.

Now, the jury would still be out as to how effective those actions are going to be because they have set many things in motion, but the results are not in.

Chairman **Glenn**. This is a unique industry and so I do not disagree with your statement that we need a specialized group to look at it, but in almost every other function of government we turn a lot of that enforcement of law and oversight of law over to EPA and some other agencies.

Are those agencies adequately staffed to do the job that needs to be done in this nuclear area?

Mr. **Peach**. If you deal with nuclear safety aspects—we have suggested in the past is you look at NRC. Something like their Advisory Committee on Reactor Safeguards could be considered.

It would be our view that they certainly have a lot of technical expertise. If they were asked to deal with DOE facilities in addition to their own facilities, I think the issue of any additional staffing or support that would have to be looked at from their standpoint.

We have not made an analysis, let us say, as to exactly how it would affect their staffing. We have looked at it from the standpoint of whether we think they have the technical skills and ability to be able to carry out that type of oversight.

Chairman **Glenn**. Well, I gather from your statement that it is your view that DOE has emphasized production over environment, safety and health in their past operations.

Mr. PEACH. I think there have been examples of that, and certainly we have seen enough examples through our work to suggest why we think this outside independent review is important. Let me cite a few of these examples, Mr. Chairman, because I think it emphasizes this point.

They called in the Roddis Panel to look at the N Reactor, and after calling them in, they decided they needed to go into a fairly immediate program for safety-related items that needed to be taken care of.

The C Reactor, and you will hear more on that from Mr. Fultz, at Savannah River is now in a shutdown condition, and has been for some time because of cracks in the reactor. More disturbing than that is the fact that DOE has not really been using over the years state-of-the-art methods like ultrasonic testing to detect cracks before you can visually observe them. Would an independent review panel have suggested that maybe there are some things that they could do there that are not being done?

The other reactors at Savannah River—and, again, Mr. Fultz has developed information on this——

Chairman GLENN. That type of ultrasonic testing, if I could interrupt just a moment, as I understand it, is required at all the electrical generating plant reactors, is that not correct?

Mr. PEACH. NRC requires that type of testing for all the commercial nuclear power reactors, that is correct.

Chairman GLENN. Yes. Go ahead.

Mr. PEACH. The other reactors at Savannah River are operating right now at a 25-percent power reduction because DuPont has become aware that if the reactors were operated at full power, the emergency core cooling system may not be able to handle it if there was an accident; therefore they have had to reduce power.

Could that have been detected, perhaps earlier, by an outside review? It has been going on for seven or eight years before they reduced the power in 1986.

Chairman GLENN. I only have about a minute left in my ten-minute time period here, but if you had to prioritize your concerns about DOE reactors and if you had to put your greatest concerns and prioritize them one, two, three, four, five, or whatever list you would have, what would be numbers one, two and three, say, that you would be concerned about today?

Mr. PEACH. The first concern would be safety of operations. As we looked at the N Reactor and what we found out about the Savannah River reactor indicates we need to try to bring an independent oversight view in there. I think that would be the major concern.

The second concern would just be the factor of, aside from safety considerations, the age of the reactors. You know, the Nation has a decision as to what its future needs are in nuclear defense production. They have to look at whether these aging reactors are going to be able to be modified, upgraded, or what have you, at some cost to provide that need.

Chairman GLENN. Well, what is your view? Do you believe that we are into a time period here now where these 30 or 35-year-old plants are going to have to generally either have major overhauls or are going to have to be completely replaced? If so, that is going to be a big and an expensive operation. Do you think we are at that time period?

Mr. PEACH. From what I have seen, it appears we are at that time period. We are certainly looking at it as we move into the 1990's, if you look at the kind of lead time that is required to develop a commercial reactor. I do not know what DOE's view would be on the lead time to build a new production reactor, but certainly when you build commercial reactors—and we are not building any now in this country—you are looking at 12 years or so for that.

Chairman GLENN. We are perhaps talking about many, many, many tens of billions of dollars, then, if we are talking about that kind of a general overhaul or replacement.

Mr. PEACH. You could be.

Chairman GLENN. Senator Cohen.

Senator COHEN. Thank you, Mr. Chairman.

I must say, Mr. Peach, that your words are spoken in a rather calm and rational manner, but what you have said is rather alarming. I think that a failure to show some response in the wake of your testimony would be almost tantamount to criminal neglect on the part of the government. It really is a rather dramatic statement you have made in a fairly soft-spoken manner and it belies, I think, the significance of the problem.

I was just musing here as you were talking. Here we spend days debating and trying in court the question of independent counsel to investigate conflicts of interest in our government, and you have apparently a rather systematic resistance on the part of the Department of Energy to any outside review as far as a safety analysis.

It strikes me as being rather ironic that we would be so concerned about conflicts of interest in our government when we are talking about the potential for hundreds of thousands of lives being at stake.

So I think we have to explore further the reasons that DOE would be so resistant to an outside analysis. Is it national security or is it simply a question, as you have put it, that perhaps their production goals are a higher priority than the safety functions that would be reviewed. I think this will be something that we will have to pursue with the Department of Energy itself.

Mr. PEACH. Mr. Cohen, if I could make a comment on that just to provide some insight, as I said, we have been making that recommendation and reinforcing it since 1981. Over time, we have seen some shifting of the DOE position.

Initially, the arguments used to be on the basis of national security and not needing to let anyone in there, and also arguments on the basis that other people are not really qualified to look at these DOE facilities.

More recently, with the creation of the Assistant Secretary for Environment Safety and Health, the shifting has been to an argument that there is not a need to create another layer of oversight; that this office will provide enough oversight.

We think that office is good. We think it forms a part of DOE's checks and balances, but we still think DOE would be useful for the Secretary to have the benefit of a highly qualified technical panel from outside looking at it and saying everything is working the way we want to assure safe operation.

Senator COHEN. But as you have said, they still continue to inspect cracks in the nuclear reactors visually.

Mr. PEACH. I think that is an alarming thing. I think one of the things that you could explore, perhaps, with Mr. Roddis, who has had experience looking at the N Reactor, and may have additional views and insights on the kinds of methods and approaches being used. Certainly, they uncovered some things that needed to be looked at more closely as a part of their work.

Senator COHEN. This evolutionary attitude on the part of the Department of Energy, you may see as some sign of progress, but I can assure you that all we need to have is one accident similar to Chernobyl, and the nuclear freeze proposal of yesteryear will look like a radically conservative movement in this country.

If they are worried about the need to meet our nuclear production goals, I suggest they take a very close look at what would happen in the wake of any kind of a disaster of that magnitude in terms of those eleven production facilities.

Mr. PEACH. The one thing that we find interesting is that after Chernobyl and when it became more public that the reactor design had similarities of the N Reactor, the DOE answer was let us have an independent group come in and take a look at how safe it is operating, which is sort of inconsistent with the general position taken over the years.

But I think it was at a point in time when there was a recognition that DOE would not have credibility just to say do not worry, everything is all right at the N Reactor.

Senator COHEN. Is it not rather a shame that we have to wait for Chernobyl to highlight what was been brought before them for some years in the past?

I think we will explore this with the Department of Energy, but let me ask you, what about the shutdown of these plants? How would we go about producing the plutonium and tritium that would be necessary for nuclear weapons production?

DOE is supposed to have undertaken a study. What is the analysis so far?

Mr. PEACH. Well, I think I can best answer that in terms of talking about the two reactors that are down right now. Their statements are that they hope to be bringing the N Reactor back up this summer. I think that accounts for something in the range of 30 percent of our production capacity. The C Reactor, which is shut down right now, at Savannah River accounts for another 20 percent or so of the productive capacity. So you do have those two reactors down right now; that is 50 percent of your production capacity.

And then the other reactors at Savannah River which account for most of the remainder are operating at about 25 percent reduced power, at least for the time being. So, obviously, there is a significant loss of production capacity.

A part of the plan that we are calling for should include: here is what we have got, here is where we need to get to, and how do we get from here to there in terms of what needs to be done. What are the right decisions to modernize or improve facilities, or do we need new facilities?

Senator COHEN. Secretary Herrington came before the Armed Services Committee last spring and he indicated that he was going to call upon the National Academy of Sciences and the National Academy of Engineering to conduct a study of the eleven production facilities.

What is the result of that study? Are you aware of it?

Mr. PEACH. That study is underway. They are looking at the facilities. We contacted them, but they were reluctant at this time to be very forthcoming with information regarding the status of their work, since it was still ongoing.

Senator COHEN. Could I ask you for your personal opinion, Mr. Peach? Is it a reasonable or responsible position for this country to take that we should have one standard for civilian energy production facilities and another for the military?

We are not suggesting that we apply OSHA to the Department of the Army or any of the other departments, but is there a reasonable standard for us to adopt, and should we have one standard on civilian projects and another for military, as far as the production of nuclear power?

Mr. PEACH. Well, civilian projects have to go through a substantial licensing process; certain specific and strict standards are set down. Generally, many of these production reactors are located on very large reservations in a little different circumstance.

I think the issue that has to be raised is are the standards adequate that are being applied to these production reactors, given the use to which they are being put and having some imprimatur that, yes, they do seem to be adequate and they are being applied correctly as a result of some independent outside review looking at it. I think that would give us the kind of confidence we need.

Senator COHEN. But you are saying that the facilities that are used to produce plutonium and tritium will not have as serious an impact as those reactors that are built for commercial purposes?

Mr. PEACH. No, sir, I am not trying to say they would not have a serious impact at all. I am just saying that–

Senator COHEN. Well, you sort of suggested that when you said they are kind farther away on large tracts.

Mr. PEACH. No.

Senator COHEN. I am asking you what is the consequence to the civilian population if you had a meltdown similar to Chernobyl at Hanford?

Mr. PEACH. It probably would be beyond my technical capabilities, let us say, to be too expansive on that. But, I can say, you are dealing with serious potential impacts if you have the meltdown of any kind of reactor, whether it is commercial or otherwise.

In the case of those reactors, one of the considerations you have is what kind of containment they have around them. In many cases they do not have containment, but they have what is called confinement because they were built some years ago. Therefore, the methodology or approaches that are used to try to contain a serious accident are different.

Senator COHEN. Yes, but it is not a rationalization to say that because they were built 30 years ago, and we now know on the wings of science, which has been carried to a much further degree of knowledge, we should just simply let it stay in existence, knowing the potential consequences.

Mr. PEACH. No, I would not be attempting to rationalize that. It means we need to look at them and say what needs to be done to them.

Senator COHEN. But I am asking you again—whether it is a responsible distinction for us to make and say we have one standard over here, even though the consequences to the civilian population are just as great, and another for——

Mr. PEACH. Let me be direct.

Senator COHEN. Yes.

Mr. PEACH. The reason I am hedging on that is because I think there is a question which I cannot answer. That is whether these DOE facilities can be licensed if NRC was looking at them in the same way in which they looked at a commercial facility.

I am not sure that the answer would be yes, given when they were built.

Senator COHEN. But that does not answer the question. The question I am asking you is, should we have a different standard for military production purposes as opposed to energy production purposes?

Mr. PEACH. I am not at a point where I can come down and say we do have different standards concurrently.

Senator COHEN. Thank you, Mr. Chairman.

Chairman GLENN. Thank you.

Senator Roth.

Senator ROTH. Thank you, Mr. Chairman.

I think we are all in strong agreement that every precaution should be taken at these facilities because in the event of an accident it would be truly a holocaust. I am not quite clear from your testimony whether you are saying that, in your judgment, these facilities are currently unsafe or whether you are saying that the procedures are not adequate to determine whether or not the facilities are safe.

For example, on page 2, you say "The overall complex can be described as costly, diverse, potentially dangerous, and aging." Would you care to comment more specifically on this?

Mr. PEACH. From our perspective, Senator, we are not in a position to make the ultimate technical judgment as to whether the facilities are safe or unsafe, but we have looked at aspects of the process that is being followed, the documentation that exists, and we see a lot of examples that suggest that the right checks and balances are not in place to assure safe operation, and indications that facilities have been operating in a manner in which they could have been in an unsafe condition.

An example would be, as outlined in our testimony, that safety analysis reviews have not been completed for four of the nine facilities; inconsistent application of standards in the safety analysis reviews.

If the safety analysis review is not complete, then DOE's own process for assuring it has got a safe operation, is not there. So those kinds of examples persist to indicate that there are serious problems.

But to make the call whether it absolutely has been unsafe or not——

Senator **Roth**. So that essentially what you are trying to underscore right now is that the procedures are not adequate, is that correct?

Mr. **Peach**. I would underscore that and we can also point to examples where facilities have been operated without adequate consideration of protection of the health and environment.

The Fernald facility is one example that can be documented out of DOE's own records where production was taking precedent over environmental and safety problems in operation of the plant. If you look at the N Reactor example, without going into detail there, the fact that they had an outside independent panel come in and look at it and make recommendations that resulted in the reactor being shut down to deal with safety problems indicates there are things that should have been dealt with that were not being dealt with. Those are just a couple of examples from our statement.

Senator **Roth**. But going back to your recommendations, I can see great merit in the concept of independent judgment because I think there does come a tendency within a facility to compromise in the interest of production, and that you need the independent point of view.

In your investigation, is there any feeling within the organization itself that there is a need for independent review? We have found that, for example, in the space agency that there was not the consistency that there first appeared to be in making recommendations to go ahead.

Do you find the same sort of division or lack of organization internally in these facilities?

Mr. **Peach**. The DOE position, if it has not changed at this point, is that the creation of the Assistant Secretary for Environment, Health, and Safety will be an adequate measure to take care of providing oversight of environment and safety at their facilities, and that there is not a need for outside review.

The logic and rationale is that the production people will have their line to the Secretary to point out their perspective on the operation of the facilities and that the environment, health and safety assistant secretary from an oversight standpoint will be able to make their recommendations to the Secretary, and also to the production people for corrective actions. But there is still that resistance to the concept of having the outside independent review on a continuous basis.

The other inconsistency, though, I have pointed out is that they do and have brought in outside independent reviews for the N Reactor and, currently, the National Academy of Sciences for their other reactors. But they do not want to establish it so there is some measure of continuation of that kind of process.

Senator **Roth**. Are there any procedures at these facilities—let us say some workmen or anyone in the facilities sees something happening that they think is dangerous. Are there any procedures to bring that to top management attention or do they have to go through all kinds of red tape?

Mr. **Peach**. I am not conversant with exactly what exists in that area. I am sure there are processes for them to bring it to management's attention, but exactly what level of management, and how those kinds of concerns may or may not be treated could be an issue.

Senator ROTH. Would it be desirable to have some process; if a worker, for example, saw a problem, that it could be brought to top attention without going through long delays?

Mr. PEACH. I think it has some desirability. We have not investigated them, but I know more recently in the last months there have been some allegations regarding workers' expression of concerns at Savannah River about certain activities that were occurring in the workplace and then how those workers that made the allegations were treated and how their allegations were handled. This includes the fact that some of the workers who made the allegations allegedly were terminated from their positions. They felt their termination was connected to those allegations.

We have not investigated that ourselves, though, to look into the details, or been asked to.

Mr. FULTZ. In addition, sir, last fall Chairman Markey on the House side had hearings which covered complaints from workers at, I believe, the Fernald plant in Ohio regarding some safety concerns at that facility.

Senator ROTH. That is all the questions I have now, Mr. Chairman.

Chairman GLENN. Thank you.

Senator Adams.

Senator ADAMS. Thank you very much, Mr. Chairman.

Mr. Peach, I will reserve some of the more detailed questions on the N Reactor to Mr. Roddis when he appears, but I want to make it very clear first that you are aware of the fact in your investigations, are you not, that there is no containment vessel at the N Reactor?

Mr. PEACH. Yes. They have what they call confinement there.

Senator ADAMS. And confinement consists of a little concrete building over the top of it with certain procedures that go with it in terms of cooling water, and so on, that could come in, and these go into ponds which could then circulate into the Columbia River after a period of time, if necessary, correct?

Mr. PEACH. That is right, and it has filtering systems and a series of cooling approaches.

Senator ADAMS. Now, I would go into more detail there, but it is hard to express the outrage that a number of us have over the lack of criteria and procedures that allow either the government or anyone else to look at what are serious both environmental and safety problems.

Now, one of the critical issues raised by the Roddis Panel and others is the need to establish criteria and procedures, and since you are testifying from GAO, I want to focus on those because that, I know, is your area of speciality.

Now, what is your understanding of what are the criteria and procedures that DOE currently uses for determining the safe operational life of facilities like the N Reactor and Savannah River?

Mr. PEACH. All right. When we did the work that I referred to for Senator Glenn on DOE's own safety analysis reviews that they are supposed to have at every facility, we found that they were not completed for four of the nine. We also found that inconsistent criteria and standards were used from facility to facility.

In other words, there were no common criteria or standards. Each facility was deciding on what they wanted to do on their own. One of our recommendations was that they get some commonality in criteria and standards similar to the Roddis recommendation, and they now have a number of actions that they say are underway which are designed to provide more common criteria and standards.

If I can go back to something Senator Cohen said, too, you have a connection there. For example, what standards should be applied to DOE facilities—get those clearly set up and have somebody look at them and see if they make sense.

Senator ADAMS. That is what I am asking, Mr. Peach. That was precisely my question. Are you aware and can you state to the Committee what the criteria and procedures are for DOE, for example, of when the reactor should be shut down, when it should be reopened, and when it should be closed? Are those in existence?

Mr. PEACH. To my knowledge, no.

Senator ADAMS. So we have each one operating on an ad hoc basis?

Mr. PEACH. That is our understanding. That is correct, sir.

Senator ADAMS. That is what I am asking about because we have a situation that involves both reopening one that is presently closed and the N Reactor which is at a state in its life where it is approaching a period beyond its useful life, and I wanted to know if there are any established criteria within DOE for determining those time points.

Mr. PEACH. Again, not to my knowledge; that does not exist. The kind of strategic planning we are calling for would move in that direction of what can you do with these aging facilities, when do you need to bring one off line, when do you need to bring a new one on line, which ones can possibly be modernized, what kind of actions would be needed to modernize them and at what cost.

Mr. FULTZ. If I could add, sir, when Mr. Roddis was charged by DOE to review the N Reactor in the State of Washington, there were well over 100 recommendations regarding actions that should have been taken that were identified by the officials who run that complex.

He can perhaps address that in greater detail, but I would stress that several of those recommendations did concern various aspects of safety of the N Reactor, and I believe some of those have been a concern for a long period of time.

What that tells us is there has been a need for improvements in safety areas at the N Reactor for a number of years. When Mr. Roddis' panel was charged with reviewing the reactor, they reviewed those recommendations and I assume that played a major part in the recommendations which he and his colleagues made.

Senator ADAMS. Would you be able to submit for the record your recommendations of the criteria and procedures that you believe should be used to meet those three points that I mentioned, opening, closing, and termination and move to a new one?

Mr. PEACH. We might be able to address that better from the standpoint of the kinds of areas where criteria are needed. Whether or not we would be able to arrive at and specify exactly what the criteria ought to be——

Senator ADAMS. But the procedures would be most helpful because that brings me to the question you mention in your testimony and why many of us have little confidence that if they do not have a plan and they do not have a criteria for closing, do you know of any criteria for opening or for proceeding with a replacement production reactor or reactors for both plutonium and tritium?

Mr. PEACH. No. I think it would be something you could explore with DOE, but I think that, you know, they——

Senator ADAMS. But you did not find it in your——

Mr. PEACH. They make those decisions when they shut one down in terms of what their timing is, what they think it will take them to correct the problems and bring it back on line.

Senator ADAMS. All right, but your examination did not reveal that that was in place, so that as Senator Cohen and the Chairman said, somebody can look at it and make a determination in an appropriate time period of what action should be taken?

Mr. PEACH. Right.

Senator ADAMS. It does not exist now. What I am concerned about is we may be, with an aging facility, getting ready to jury-rig a civilian facility and throw it into an already jury-rigged system.

Did you see any recommendation for doing that, as opposed to going with modern technology and building whatever is required for national security?

Mr. PEACH. The one thing that I am aware of that DOE has had on the books for a long time is a look into the future of what the defense complex should be like 30 years into the future. However, I understand but it is not being pursued with any urgency and a fairly low level of effort.

But what we are suggesting, again, with the overall plan is that, given the old facilities, it should address questions like, should I try to modernize them and bring them up to current standards or would it be better to start from scratch with something new. What is going to be most cost effective to get what I think I am going to need in the future?

Senator ADAMS. And that does not exist?

Mr. PEACH. That kind of road map is not there.

Senator ADAMS. And therefore, if we do not change this and look at a strategic plan for, say, a new production facility, we would end up with one being closed and then a scramble to try to jury-rig something else to put in place.

Mr. PEACH. I make the comment in my statement that you will be looking at continuing to make decisions on a piecemeal basis and react to individual situations rather than trying to proceed in some more systematic, planned fashion.

Senator ADAMS. I will ask this of Mr. Roddis, but I wanted to be certain whether you had looked at it. In your examination, did you come across the fact that the recommendations that were made by that panel to be done by the N Reactor before it was reopened have not been completed and will not be completed before the scheduled date of reopening?

Mr. **Fultz**. We have a current review underway at this time which is evaluating those recommendations and providing status reports on what is occurring at the N Reactor, sir.

Senator **Adams**. So you do not have a conclusion yet?

Mr. **Fultz**. We do not have a conclusion, no.

Senator **Adams**. But you will be giving one to the Chairman?

Mr. **Fultz**. Yes, we can.

Senator **Adams**. Good. Thank you, Mr. Chairman.

Chairman **Glenn**. Thank you very much.

Just a couple of follow-up questions here. In answer to a previous question, if I heard you correctly, I think I understood you to say that DOE operated the reactors at Savannah River for six to seven years at a power level such that if there had been an accident, the emergency core cooling system would not have been able to handle it. Is that correct?

Mr. **Peach**. As I understand it, that is what their current data shows which they are now evaluating further, but pending that evaluation, they have reduced the power levels by about 25 percent for those reactors and, you know, they have been operating at that higher level for the last seven or eight years.

Chairman **Glenn**. Well, when we talk about the emergency core cooling system now, we are saying if it is inadequate and we had gotten into trouble, we would have had an uncontrolled meltdown at Savannah River?

Mr. **Peach**. That is the risk if the emergency core cooling system is not adequate.

Chairman **Glenn**. We have been lucky.

In all the groundwater contamination, aquifer level contaminations, and so on, that have occurred at different places around the country which you have looked into, do we have the technology and the knowledge of how to clean this up?

Mr. **Peach**. I am not sure that we do. I think that is something that even in trying to decide on clean-up actions that DOE would have to work with EPA on, because that is a problem that EPA struggles with, you know, cleaning up these groundwater problems. That is going to be a difficult issue on a national basis.

Chairman **Glenn**. Well, it is one thing to say that we can design new plants, we can put fixes into plants, we can increase safety there, we can make sure that there is not something like a meltdown.

But I have not been at all certain in what I have looked into so far that we even have the technology or the knowledge of how to go about cleaning up some of this creeping radioactivity off the base or off the site and contamination of aquifer levels, wells contaminated, and so on.

You said in your testimony, I believe, that at some of these places drinking water is hundreds to even thousands of times above what is considered safe standards. Is that correct?

Mr. **Peach**. That is correct. That is on-site location. DOE's position in discussions with us has been that people are not drinking that water; they do not depend on it for drinking water.

Chairman **Glenn**. Well, at Fernald in Ohio, we have had to close up some wells off-site, so we know this works down through the aquifer level. Do we even know how to clean that up?

I guess the only way anybody has come up with yet is you try and get water to flood an aquifer level. You know, the solution to pollution is dilution, the old bit, and that does not work with radiation.

Mr. PEACH. And when it goes off site, that is a real concern. If you would allow me a personal observation not documented specifically by all of our work, but when you deal with the level of contamination on site at some of the facilities, you may be well dealing with a long-term care kind of a situation.

In other words, even if you stopped production at facilities, you would have to have long-term care in place because of the level of contamination that exists.

Chairman GLENN. Just one final question, then I will turn it over to Senator Cohen for any follow-up he may want to make. In your view, does the amount of money allocated by DOE thus far for improving environmental and safety problems at its facilities indicate that DOE sees these problems as among its highest priorities?

Mr. PEACH. The information we have seen from the budget would indicate that that is probably not the case. I think it is more in the range of about nine, ten percent in terms of what they are allocating into that area, although I will say that we do not think they have defined the extent of the problem they have got to deal with. So it is hard to make the best budgetary decisions if you do not understand the extent of the problem you are trying to deal with.

Chairman GLENN. Well, nine to ten percent would be of the total DOE budget is being, what, devoted to environmental clean-up and safety now, or just general reactor safety?

Mr. PEACH. Environmental clean-up. I am talking about the defense nuclear budget. Nine to ten percent of the defense nuclear budget, which is about $8 billion in the last few years, has gone into the environmental/safety area, and I believe that in looking at that definition, those more or less are the DOE numbers in terms of how they categorize things as being environmental and safety.

Chairman GLENN. Well, I guess we have to come back to our original question that there is no answer to right now, and that is what the estimate would be of a total bill for clean-up. I guess we do not really know that.

Mr. PEACH. And they have a number of projects underway, most, as we see it, in response to our recommendations to try to begin to get a handle on that.

Chairman GLENN. Do you think it is possible to get an overall estimate of what the total bill would be to clean this whole thing up?

Mr. PEACH. I think you can. It might not be perfect in terms of making sure you have identified every last thing, but I think it will be much better than we have. If you just look at Hanford, we had suggested from our work that the number of sites that required cleanup was about 750 compared to the 300 or so sites DOE had identified.

They have now identified over 650 sites at Hanford. So in other words, you can get closer to where you ought to be in understanding what the scope of the problem is.

Chairman GLENN. Well, it is something we cannot delay doing any longer.

Senator Cohen.

Senator **Cohen**. A couple of comments, Mr. Chairman. I still think that the great benefit of this hearing has been at least to stimulate us to consider the question as to whether or not pursuit of national security should be allowed to pose an unacceptable risk to national safety.

We have never really posed the question in terms of national security versus national safety, but I think that is precisely what the issue is in this case. I am often struck by some of the paradoxes in life and occasionally by many of its absurdities, but I must say I find it paradoxical, if not absurd, that Senator Glenn and I will be called on this year and next year and the years to follow to examine the question of SDI, which, assuming that it works, hopes at least to protect us against the most advanced nuclear missiles that the Soviet Union could possibly launch.

SDI cannot hope to protect us against our most obsolete nuclear production facilities, and yet we are going to be willing to spend billions, if not trillions of dollars in pursuit of this shield against nuclear destruction coming from space, as such, but launched from the Soviet Union.

We are unwilling at this point to even consider how many billions of dollars it would cost to correct some of the deficiencies that pose an equally dangerous threat to our own citizens.

I would hope, Mr. Chairman, that out of this hearing today that we would start some sort of a debate about the standards that have been imposed upon these facilities.

Chairman **Glenn**. I could not agree with you more. I think we have two levels that we are considering here. One is the reactor safety immediately, and that involves the spectre of a Chernobyl happening.

On the other hand, we have to address the clean-up of the contamination that has occurred on and around some of these sites, and that, in effect, is almost a creeping Chernobyl. It is an insidious thing; it does not happen all at once. It is not a bang, it is not a meltdown, it is not spraying stuff out where you track the winds and know exactly where it went.

It is something that has crept in there perhaps because we know more about it now than we knew 25 or 30 years ago, but it is every bit as serious as the possibility of a meltdown that we try and protect against, as far as I am concerned, because it is sort of a creeping Chernobyl. It eases out into the communities and you do not really know it until somebody tests a well someplace and finds out, lo and behold, it is now radioactive.

So there are two levels of things that we have to approach here and it is not going to be easy to do it and it is not going to be cheap to do it, as I see it, but I think we can no longer afford to just avoid it.

Well, Mr. Fultz, we have kept you here. We look forward to getting your testimony specifically on Savannah River and what has happened there. Would you go ahead either with a summary or with your complete statement?

Mr. **Fultz**. Yes, I would, sir. I would like to have Ms. Gary Jones join us at the table. She was the evaluator in charge of this particular assignment, which, as you know, is still ongoing.

Chairman GLENN. Fine. Ms. Jones, welcome.

Mr. FULTZ. I will limit my comments or summary to approximately five minutes. I would, of course, like my entire statement entered into the record.

Chairman GLENN. Your entire statement will be included, without objection.

Mr. FULTZ. We appreciate the opportunity to discuss our ongoing work for this Committee concerning various aspects of the DOE production reactors at Savannah River. Our work is not yet complete. Therefore, the information we will be discussing today is subject to change.

Although our audit work is still underway, some of the issues we have identified to date are potentially very serious. When these issues are taken together, the overall message they convey is a need for better management of the Savannah River complex.

I would now like to discuss specific concerns that we have identified, beginning first with the issue of testing for cracks. Stress corrosion cracks have been identified in the C Reactor stainless steel tank wall. Because the cracks could not be repaired, it has been shut down since July 1985.

DuPont's inspection method for the reactor tanks relies heavily on visual inspections with a periscope. This method has limitations because there is no assurance that all the weld areas have been identified, because an oxide build-up on the tank walls may obscure identification of the welds.

Last fall during a maintenance shutdown of the L Reactor, marks were identified that might have been cracks. About half of these marks identified were dye tested to determine if they were, in fact, cracks. After this testing, no cracks were found and the L Reactor was restarted in December 1986. Although the dye test used for the L Reactor can identify cracks better than visual inspection, it is limited because it cannot determine a crack's depth.

The commercial nuclear industry, as we have discussed earlier here today, uses ultrasonics to inspect reactor vessels. An ultrasonic inspection program will locate the weld areas and can determine with better accuracy than a periscope a crack's depth. The ultrasonic testing could also determine the length of a crack.

Although DuPont plans to begin ultrasonic testing in the L and K Reactors in 1988, it will only inspect a portion of the tanks during each reactor's normally scheduled maintenance shutdown so that production will not be affected. This is what they told us very recently.

I will now discuss the issue of reduction in operating power, which we have addressed here this morning, so I will just highlight those comments.

In November 1986, DuPont reduced the operating power levels of the reactors by about 20 percent. They were cut an additional six percent in December. These reductions were made necessary by information developed by DuPont's Savannah River laboratory which reviewed the power limits established in 1979, as Mr. Peach has mentioned.

The laboratory's preliminary report states that the model used to calculate the power limits has a number of limitations. Although the laboratory is still studying the limits, DuPont is assessing a number of options to compensate for the problems raised by the 1979 experiments so that higher power levels can be resumed.

We have also identified other concerns that could further affect the safe operation and maintenance of the Savannah River reactors. In 1985, DuPont established a reactor safety evaluation division to provide safety oversight.

We have reviewed several of this division's reports and they generally conclude that no effective management system exists to ensure timely clearance of action items related to reactor operations.

It's June 1986 report points out that the backlog of recommended actions for the reactor incident report system is large and growing. As of the end of 1985, 198 recommendations, some dating back to the late 1970's, were still outstanding.

In addition, in a November 1986 letter the reactor safety advisory committee stated their concern about the backlog of reactor incident report recommendations, and I think this is a very important quote. They believe that the backlog may indicate a trend toward a gradual deterioration of safety at Savannah River operations.

Both DOE and DuPont reports and safety appraisals have raised concerns about numerous aspects of the reactor maintenance program. These reports have stated that, and I am quoting from one of these reports, "some maintenance activities are being conducted with little or no procedural guidance."

In addition to that, our work has shown that classroom training is not provided on the specific reactor systems and equipment on which the mechanics work.

Now, the above comments are important because 40 percent of the maintenance workforce at Savannah River are not trainees. Therefore, we are concerned that inexperienced personnel are maintaining the reactors without adequate training and, in some cases, without proper written procedures.

Just summarizing, we are concerned that management inattention contributed to the operations and maintenance problems that we have described here today. Many issues are just now being addressed. If operations at Savannah River are to improve, we believe they now must become a high priority.

That concludes my summary and we would be glad to respond to any questions you have.

Chairman GLENN. Thank you very much. In your look at the safety at Savannah River and the cutback of 26 percent, I believe it is, you said——

Mr. FULTZ. Twenty-five to twenty-six percent, yes.

Chairman GLENN. Twenty-five to twenty-six percent. As I understand it, they are still investigating; there are continuing, ongoing studies of what the safe level is for the existing emergency core cooling system. Is that correct?

Mr. FULTZ. That is correct. If I could describe, sir, those experiments that were done in 1979 were evaluated some time in 1986 by the DuPont laboratory not as an ongoing safety oversight program. The laboratory was reviewing a hydraulic system, I believe.

In that process, they discovered limitations in the model which was used to develop the power limits. And in reviewing those power calculations in November, they realized that mistakes may have been made and decided to cut back power 20 percent.

This apparently raised concern within the DuPont complex because they were, in late November, early December, continuing to evaluate the 1979 model. During that work, they identified an error in implementing the reduced power levels and had to cut back power an additional five to six percent. That is how we arrive at the total of 25 to 26 percent power cutback.

Chairman GLENN. Well, are you confident in your look at the modeling—I should ask first, have you looked at their modeling for this concern?

Mr. FULTZ. No, sir. This review is still underway. We plan to get into that in detail later, but at this time we have not made a detailed analysis.

Chairman GLENN. Well, the next obvious question is whether we have a confidence level that that 26 percent is adequate, whether that was done sort of ad hoc, whether that was done off the top of somebody's head because of modeling inadequacies, and when the continuing study will show us whether it is safe or not.

In other words, the bottom line is do we really know what is safe.

Mr. FULTZ. I cannot address that question directly, but what I can do is say that in the evaluation of the model that was done in November, I understand, it was not subjected to a very extensive peer review.

Further review showed an error in implementing the new power level and a further reduction of the five to six percent had to be made. So if I had to say, I think DuPont in itself is still in the process of determining if the power levels are correct.

Chairman GLENN. How long would it take to do an ultrasonic survey of a complete unit? They do it now just during a normal shutdown period, as I understand it, for a short period of time, and before a complete containment vessel would be monitored or a whole reactor system would be monitored adequately—as I understand it, they do just part of this each year and it would result in many, many years before we would have a complete analysis, an ultrasonic analysis of the whole unit.

How long would it take to shut down and do it all at one time so we would know what was going on with that particular vessel?

Mr. FULTZ. We do not know how long it would take if they shut the reactor down and did it all at one time, sir. The current plans, however, by DuPont are to do periodic testing of a certain percentage during a normal maintenance shutdown. Their plans are not to shutdown and do the ultrasonic at one time, as we understand it today.

Chairman GLENN. What I was trying to get at was if we did that so we would have a higher confidence level that there is nothing wrong with that particular reactor, then we obviously would go ahead with a greater confidence level than we could otherwise do.

I was trying to get an idea of whether this would interfere with their production schedules in a major way, how expensive it would be, whether it is something we can consider pushing for without interrupting the production flow other than normal shutdowns.

Ms. JONES. When L Reactor was recently shut down in July of last year, they went in to do some extensive testing on marks that were discovered. While they did not do ultrasonics, they did visual testing, and they also did some dye testing. They were down five months for that. Normal extended shutdown is about 50 days.

DuPont told us that to do a hundred percent inspection ultrasonically would take longer than their normal shutdown. I cannot give you a time period. We will be happy to provide that, but it would be longer than their scheduled outage.

Chairman GLENN. Okay. What do you feel right now? Are the SRP reactors safe at the current levels?

Mr. FULTZ. As Mr. Peach mentioned, we do not have the technical expertise to respond to that. However, I will say that our views are based on the safety reports which have been done by internal DOE and DuPont officials at the complex and the comments they have made and the concerns they have raised. Given that and the inexperienced mechanics which have made the repairs over a number of years, in many cases without the benefit of formal written procedures, I at this point do not have the assurance that I personally would like to have that the reactors are operating in a safe manner.

Chairman GLENN. The cracks are a very serious concern. Give me some idea if you can, out of your expertise, as to how these progress. Is this something that would occur and once it has occurred and we are up to certain levels, it is not going to get worse, or are these things all progressive and if we find a crack of any kind or we do ultrasonic testing and we find minor cracks, is that something that is liable to expand? What is our knowledge in this area?

Is it once you come on stream, certain cracks would develop, then they would be static and you would be safe to operate with them forever, or are these things all likely to develop to a disastrous situation some time if we keep operating above certain levels?

Mr. FULTZ. Okay. If I could answer that in two ways, sir, first, when the cracks were identified in the C Reactor, these were initially done by visual and dye testing. DuPont did do ultrasonics on the C Reactor as further testing.

The ultrasonic that was completed on C showed, I think, three important things, and we have been told this by a DuPont official, that there were more cracks than what were originally identified on C. The cracks were longer and deeper than what they had anticipated. I think that is significant.

If a crack does occur and it is repaired, it of course, would have to be monitored. Cracks can and do grow. In fact, they have established a critical crack length for the L Reactor tank midwall, of 23 inches.

Mr. PEACH. I might add, Mr. Chairman, I think one of the problems they are having with that C Reactor is finding a way to repair the cracks because the repair methods that they had been using to repair the cracks are interacting with the reactor as it has been bombarded with radiation in such a way that it is continuing to cause cracks.

So they have not been able to find an adequate repair method yet. That has been one of the reasons it has been down for an extended period of time.

Chairman **Glenn**. So just welding it does not necessarily solve the problem?

Mr. **Peach**. Well, you are looking at the conventional methods that they have employed in the past and they are trying to explore and look at what alternative methods there may be to use to try to repair the cracks.

Chairman **Glenn**. Do you want to comment on that?

Ms. **Jones**. Yes, sir. In 1968, there were cracks that developed in the C Reactor tank. They did repair those cracks by welding a patch over the cracks. The new cracks that they are concerned about now started to leak in 1984.

They tried to use the same welding repair methods. It is not working. They are now looking, as Mr. Peach said, at alternative repair methods.

Chairman **Glenn**. In your opinion, would this cutback in the power of 26 percent leave us, then, that if we did have a problem—let us say the cracks are larger than anticipated and let us say we really did have a break there and something happened.

Operating at a reduced 26 percent, is the emergency core cooling system capable of handling that, in your——

Mr. **Fultz**. In the opinion of the laboratory, the power levels that they are operating on are at a conservative enough level to handle an accident. That is their feeling at this point.

Chairman **Glenn**. That is the basis of the 26-percent reduction is to get it within the capacity of emergency core cooling to handle it?

Mr. **Fultz**. That is correct. That is their opinion to date, sir.

Chairman **Glenn**. But the study is ongoing on that?

Mr. **Fultz**. It is ongoing.

Chairman **Glenn**. What is our time frame on the study? Do we know?

Mr. **Fultz**. They expect to have that done this fall, I believe.

Chairman **Glenn**. Is the National Academy of Sciences review sufficient in terms of GAO's concern about outside independent review?

Mr. **Fultz**. As Mr. Peach mentioned, the policy of the National Academy of Sciences—and I in no way mean this in a derogatory sense—is not to share what they are finding at the Savannah River complex.

I would add that they have been charged to review all of the eleven reactors—some of these are research reactors—within the DOE system. They expect to complete their effort and issue a report some time late this year or early 1988.

Chairman **Glenn**. What is the problem with them sharing information so you can look at it together?

Mr. **Fultz**. If they are willing, sir, we are willing to listen.

Chairman **Glenn**. Well, what have they told you? Why are they not sharing information? Good heavens, this is important enough that we should not be worried about little turf fights as to who is investigating what.

Mr. **Fultz**. They have told us what they are doing; they are just not sharing with us their findings or what areas that they might be developing. That is their policy, sir.

Chairman **Glenn**. We may want to inquire further into that.

Do you have any other questions, Senator Cohen?

Senator **Cohen**. I was not clear when you said there was about a 50-day waiting period for a normal shutdown.

Ms. **Jones**. The normal scheduled maintenance outage for the reactors is about 50 days.

Senator **Cohen**. And how much of a portion of the screening or the survey would be involved of the reactor itself? Would that be a complete——

Ms. **Jones**. For the visual inspections, which has been their policy, they have been doing 20 percent per year. The last information we had on what they planned for ultrasonics was that they have not developed a percentage to date, Mr. Cohen. They do not know yet what they will do; they have not decided.

Senator **Cohen**. How long does it normally take for, say, a civilian reactor?

Ms. **Jones**. In the commercial sector, their policy is to do about ten percent per year so that over a ten-year period they have a full inspection.

Senator **Cohen**. And how long do they have to shut down to accomplish that ten percent?

Ms. **Jones**. I do not know, Mr. Cohen. We could provide that for you.

Senator **Cohen**. That would be helpful, I think, for us in light of the Chairman's question.

Ms. **Jones**. Certainly.

Senator **Cohen**. Again, I was just struck by the notion of a shutdown for 50 days to perform such a maintenance check—Judge Walsh, independent counsel in the Iran/contra investigation, requested yesterday that our special Iran committee shut down 90 days to give him time to look at that.

In terms of priorities, in terms of days, it is just striking to me and I am curious. It does not seem like an unreasonable period of time to even double that time to have a reasonable inspection done by ultrasonics.

Chairman **Glenn**. Thank you very much.

I hope that in case other members of the Committee or staff have questions that we wish to have answered for the record, you could respond to those as expeditiously as possible so they could be included with the record.

Thank you very much.

Mr. **Peach**. Thank you, Mr. Chairman.

Mr. **Fultz**. Thank you.

Chairman **Glenn**. The next witness is Mr. Louis H. Roddis, consulting engineer. I will not read his whole biography here, but he has a very lengthy and broad background in this area and has worked in the field for a number of years as a consultant, as a professional in this field.

Mr. Roddis, we look forward to your testimony this morning, and proceed. Welcome to the Committee.

TESTIMONY OF LOUIS H. RODDIS, JR., CONSULTING ENGINEER [3]

Mr. RODDIS. Thank you, Mr. Chairman. As you mentioned, I am a self-employed consulting engineer and a member of the National Academy of Engineering.

The principal focus of my recommendations to the Secretary of Energy are that the N Reactor should be replaced as soon as possible. In the short term, it should be shut down until a number of changes are accomplished, the chief one, in my estimation, being the inerting of Zone 1 of the containment, as is done in over 25 percent of the power reactors in the United States today, including the Washington Public Power Supply System unit 2 that is at Richland.

A very brief summary of my recommendations are as follows. One, I recommend the Department shut down the N Reactor permanently unless a positive judgment is made that the requirements for defense material warrant accepting public hazards exceeding those of commercial reactors.

Two, if continued operation for the next several years is considered to warrant acceptance of these hazards, then a short-term action plan should be provided and fully executed based on the various sources of recommendations identified in the recommendations section below.

Briefly, these include the 88 recommendations of the departmental review teams that have just reported to you, and some additional steps, especially those aimed at reducing the potential for a hydrogen explosion.

Three, if continued production of defense materials is required long term, replace the N Reactor by a less unique design, with provision for accident mitigation similar to commercial reactors. This will be a challenging task, but is not a new idea. It was studied extensively in the 1982 timeframe but never executed.

Besides answering any questions on this report, I would like to discuss three more general items that were touched on in my report that are in the nature of governmental organization matters. Since they were not specifically asked for by the Secretary, they were not shown as recommendations in my report.

First, the effect of the federal budget process on safety. In a licensed reactor, including federal, State, and municipally-owned ones, the utility must spend whatever funds are required by the NRC to effect plant safety and take their chances on recovering these expenditures some time in the future, if ever.

The DOE, however, has to get funds in advance from the Congress, OMB, and its own internal processes, with no special emphasis on nuclear safety. I have no specific recommendations. Certainly, the federal budget process is sufficiently complicated without any ideas from me.

Chairman GLENN. You might as well make some suggestions; everybody else does.

Mr. RODDIS. Well, I have two positive suggestions coming, sir, but not on the budget process, except to spend the money to do it, which is the fundamental recommendation.

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[3] See p. — for Mr. Roddis' prepared statement and attachment.

Secondly, the responsibility for the safety review process is somewhat diffused in the Department, in that the contractor, the field office, the program headquarters office, and the headquarters environmental, safety and health office are all involved to some extent in the safety responsibility process.

While ESH does have shutdown authority, it is in case of overriding need only. In other words, ESH has to positively show something is unsafe rather than the opposite. Also, the position exists at the pleasure of the Secretary. Secretary Herrington should receive great credit for establishing the position at its present level, but another Secretary could greatly change the emphasis on this function.

Therefore, my first recommendation to this Committee is that the position of Assistant Secretary for Environment, Safety and Health be established as a statutory-required position in the Department of Energy.

Thirdly, there is need for a credible, permanent outside review of the DOE activities in the nuclear safety area. Both the independent consultants group, of which I was one, and the National Academy of Sciences review committee are ad hoc and one-time in nature, and while I believe them to be credible in themselves, there is no question in my mind but that a permanent overview body should be established.

I do not think it appropriate for the NRC to be involved directly, but perhaps the Advisory Committee on Reactor Safeguards could be utilized either in its present form as an NRC-appointed body or, better yet, as one appointed by the President with an overview function for both the NRC and DOE.

Until the division of the Atomic Energy Commission, the ACRS did function in this way. I believe it can still do so at the request of the Secretary, but this has only been done on rare occasions and there is the problem of staffing and funding for such work, since the ACRS is now appointed by and supported by the NRC.

This leads to my second recommendation that the Advisory Committee on Reactor Safety be utilized by the Department of Energy to perform an overview of the Department's nuclear safety reviews in the same manner it does for the NRC-licensed reactors. This should include required public reports on the construction and operation of these reactors.

In conclusion, I respectfully request that my entire October 3, 1986, report to the Secretary of Energy and the attachments thereto be made a part of this record, sir.[4]

Chairman GLENN. We will indeed do that, and I believe we have a copy of it right here.

Mr. RODDIS. Yes, sir, you have a copy.

Chairman GLENN. It will be included as part of the record.

That has been released in the past, I believe, has it not?

Mr. RODDIS. It was released December 12th or 14th by the Department, sir, yes.

Chairman GLENN. And it is available to the press? Where do we get copies of that?

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[4] See p. 255 for the report and attachments.

Mr. RODDIS. It was available at that time to the press.

Chairman GLENN. It was available at that time, okay.

I might just comment that in the legislation that we are putting together now and will be submitted shortly, the ACRS is included in that legislation as past of an oversight body for DOE in improving those designs.

You said that you considered the safety review process at DOE as somewhat diffused. How would you suggest focusing that responsibility?

Mr. RODDIS. Well, as it stands at the moment, the Office of Environment, Safety, and Health is a staff function in the headquarters. The people who actually do most of their work are in the field offices and report to the program office because the field offices report to the program office.

This is a little bit like the NRC operating with total dependence on the licensee with only a Washington headquarters, and I think this diffuses the responsibility around a little bit too much.

Chairman GLENN. If we shut down the N Reactor, are there other facilities that could pick up that production load, to your knowledge?

Mr. RODDIS. Well, sir, that was gone over earlier. I only know in general the current status of the production story. I, of course, grew up with it and know how it was put together, but with one reactor out of service at Savannah River and one at Hanford, approximately half our production capacity is inactive. How much we need, I have not been close to in 25 years.

Chairman GLENN. You say we need a different kind of reactor, less unique design, one that was more similar to our commercial reactors. You said that would be a challenge. Do you think that is quite doable, though?

Mr. RODDIS. Well, it is a time question, sir. If it had been started in 1982, we would be having it on line in 1992 and it would be a fine thing. There were designs carried on quite extensively. There was a public report made by Keith Glennon and his committee. It is just a shame that the government elected not to move at that time.

Chairman GLENN. I do not want to draw too many parallels here because it is a different area of science, but I was interested in your statement that ESH must show that it is unsafe rather than guarantee that it is safe.

Mr. RODDIS. Sir, I am aware of the analogy that you are discussing.

Chairman GLENN. The analogy I am about to make, you are already aware of.

Mr. RODDIS. I think it is dead wrong.

Chairman GLENN. It crept into our whole NASA syndrome over the past several years; I guess you could call it a syndrome at NASA. People were not guaranteeing it is safe, with no doubt. They were saying, well, maybe we can get by with a little less than we did previously.

Mr. RODDIS. It is certainly not the way the NRC treats a licensee. When they tell you to shut down, you do not argue.

Chairman GLENN. And your point about the constancy of what dollars are needed to do the job is a point very well taken, and I think what we are learning at the hearing this morning here points in the direction that we have to have some sort of funding or contingency funding that is already there and available to the Secretary to do what has to be done.

This is not something that can be turned on and off like a spigot from one budget to the next.

Mr. RODDIS. I could not agree with you more, sir.

Chairman GLENN. It is something that has to have a constancy to it, and it would appear to me that this is going to be a lengthy process. We are talking about quite a number of years here, and from what we have already heard, I do not think anyone knows how many years.

I do not know whether you have gotten into some of the environmental concerns around this or not, but do you think we really have the technology available to clean up aquifer levels and this creeping business that is getting off the sites? Do we have the technology?

Mr. RODDIS. Some of the environmental problems are clearly going to be very long term to clean up and we may not have the technology. To solve the problem of updating the production chain all the way from the reactors, the chemical processing, the fuel fabrication and the weapons chain, is certainly within our current technology. It is clearly a multi-billion-dollar program.

Chairman GLENN. Could you elaborate on your testimony about Mary Walker's shutdown authority? I am particularly interested in your understanding of "overriding need."

Mr. RODDIS. I do not have the order in front of me here, but those are the terms and I would suggest that you ask her, sir, the limits of it. The order is a Secretary's order which lasts, I believe, for one year, and that is an automatic thing. They normally reissue them on an annual basis.

It is a one-pager and it basically says that the responsibility ultimately can be exercised in case of an emergency, providing there is overriding need shown. It simply puts the shoe on the wrong foot, in my opinion.

Chairman GLENN. Could you go into a little more detail on your views about the need for a permanent outside review? In particular, could you talk about your suggestion that ACRS be the outside review?

I guess I have already indicated that we have that included in our legislation now, but I am a little concerned. There are pros and cons of using ACRS, as it is presently constituted, as opposed to having a completely independent body appointed by the President.

This would be expanding considerably on ACRS' activities. The numbers of people would have to be increased. There would be an expansion of that whole outfit if we gave them this responsibility, also.

Are there pros and cons of ACRS as opposed to an independent body appointed by the President?

Mr. RODDIS. Well, in the first place, I think that the key item here is to get people of competence with technical background. The ACRS has a long history of being such a group. It has been appointed in the past, staffed and funded—and I would like to point out that it is very difficult for an expert group to work without a proper staff and proper funding—by the NRC.

It worked very successfully, including the DOE reactors, during the time of the old Atomic Energy Commission format. When the break-up occurred in the mid-1970's, the function was transferred to the NRC, as was quite proper.

I believe legislation still exists which allows the Secretary to call on that, but if he does, there is no mechanism for funding and there is no input for him to provide staffing.

My point is that a single committee would at least apply a common set of standards to this business. Part of the problem is that although there is no legal question, it is clear that the same kinds of detailed standards are not being applied to the DOE reactors that have been applied to the NRC-licensed reactors, with many changes in the last ten years.

Chairman GLENN. Are there any differences between the production reactors and that whole system as opposed to the civilian use, the regular electrical power plants? Are there differences enough in the technology that ACRS would have any problems in looking at the production process as opposed to the electrical generating process?

Mr. RODDIS. No, sir, I do not see——

Chairman GLENN. Basically the same?

Mr. RODDIS. For the experienced technical people, basically the same.

Chairman GLENN. Yes, fine.

Mr. RODDIS. The fundamental difference is the production reactors were built at a time when they did not consider it necessary to put them in containment.

Chairman GLENN. We had a news clipping here from the Wall Street Journal back on May 2, 1986, not quite a year ago, and in that the Secretary of Energy, Mr. Herrington, is quoted as saying—this is following the Chernobyl disaster and comments on it—he ordered some reviews and the review of the whole production cycle, and particularly with regard to Hanford because of its similarity to Chernobyl.

This states that, "Although ordering those reviews, the Secretary asserted yesterday that Energy Department reactors 'are as safe as any in the world today.' " Would you agree with that?

Mr. RODDIS. No, sir; I did not at the time.

Chairman GLENN. And I think your testimony indicates your concern about that, too.

Thank you very much, Mr. Roddis. You have been very helpful.

Mr. RODDIS. Thank you, Mr. Chairman.

Chairman GLENN. I hope that if we do have Committee members who wish to ask additional questions that you could respond to those for the record, also.

Mr. RODDIS. I would be happy to, sir.

Chairman GLENN. Thank you very much.

The next witness is Forrest Remick, who is Vice Chairman, Advisory Committee on Reactor Safeguards, U.S. Nuclear Regulatory Commission. Mr. Remick, welcome to our hearing this morning.

We can have either a summary of your statement or the total statement. In any event, it will be included in the record in its entirety.[5]

TESTIMONY OF FORREST J. REMICK, PH.D., VICE CHAIRMAN, ADVISORY COMMITTEE ON REACTOR SAFEGUARDS, U.S. NUCLEAR REGULATORY COMMISSION

Mr. REMICK. I will read a summary, Mr. Chairman.

Chairman GLENN. Good, thank you.

Mr. REMICK. Mr. Chairman, I am pleased to be with you today to participate in your oversight hearing concerning the amendment of the Energy Reorganization Act of 1974 to require the Advisory Committee on Reactor Safeguards, the ACRS, to review and evaluate the implementation of health and safety standards at Department of Energy Nuclear Facilities.

I am Dr. Forrest J. Remick, Associate Vice President for Research and Professor of Engineering at the Pennsylvania State University. I am here today as Vice Chairman of the Advisory Committee on Reactor Safeguards.

I understand that you are interested in the ACRS providing general information on the extent that ACRS activities are relevant to the review of DOE nuclear facilities, the extent that the technical expertise of the ACRS lends itself to such a responsibility, sources that would be needed for the ACRS to review and evaluate DOE nuclear facilities, and the ACRS interest in and availability to accept such added responsibility.

The Advisory Committee on Reactor Safeguards was established by Section 29 of the Atomic Energy Act of 1954, as amended, and transferred as advisers to the Nuclear Regulatory Commission pursuant to the Energy Reorganization Act of 1974, as amended.

The ACRS reviews safety studies and applications for construction permits and operating licenses for production and utilization facilities. It advises the Commission with regard to the hazards of proposed or existing nuclear facilities and the adequacy of proposed reactor safety standards.

Further, it reviews matters specifically referred to it by the Commission. In addition, the Committee, on its own initiative, conducts reviews of specific generic matters or nuclear safety-related items.

As part of the Energy Reorganization Act, the Administrator of the Energy Research and Development Administration, the former ERDA, the predecessor to the Department of Energy, was authorized to use, with NRC's consent, the technical capabilities of ACRS to assist in carrying out his responsibilities.

A memorandum of understanding between DOE and NRC exists concerning criteria and procedures for DOE requests for ACRS reviews of DOE nuclear facilities and activities which are exempt from NRC licensing requirements.

Since the Energy Reorganization Act was implemented, the ACRS has, in fact, participated in the review of some DOE facilities and activities, including, for example, the Fast Flux Test Facility, the Loss of Fluid Test Facility, the Shippingport Atomic Power Station Light Water Breeder Reactor, the Clinch River Breeder Reactor, and the Naval Reactors Program.

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[5] See p. 94.

Before the Energy Reorganization Act, the ACRS participated in many reviews of AEC facilities and activities, including several that DOE is now responsible for. For example, the ACRS periodically reviewed the N Reactor at Hanford and the Savannah River production reactors.

I believe that a brief explanation about the ACRS and how it operates is necessary. Members of ACRS are appointed by the NRC for terms of four years and perform the statutory functions of the Committee as part-time technical advisers. They are experienced and highly qualified engineers and scientists representing several of the key technical disciplines involved in the siting, design, construction and operation of nuclear power plants.

A list of ACRS members and a summary of each member's background are attached to my written testimony.

In addition, the ACRS has available to it the services of about 70 expert consultants. While the ACRS has offices in Washington, D.C., its members reside across the nation. The work of the ACRS is supported by a full-time staff of 20 professional engineers who provide technical support, plus additional administrative support personnel.

The ACRS members themselves serve only part-time, but the average member spends about 130 days a year on ACRS activities, of which approximately equal amounts are spent at meetings of the full Committee or of subcommittees. A comparable amount is spent doing the homework required to prepare for those meetings.

The Committee normally reviews each licensed nuclear plant twice, once at the construction permit stage, and again several years later at the operating license stage. At each stage, the review is initiated when the applicant—that is, the utility—submits a safety analysis report relating to the safety of the plant. Copies of these reports are sent to the ACRS and a subcommittee of four to five members is assigned to the project. The NRC staff, consisting of about 600 professional engineers, begins its review at this time.

When the ACRS has completed its review, the report required by law is prepared and submitted to the NRC commissioners via its chairman. Almost without exception, this report addressed a number of safety-related questions and indicates the views of the ACRS as a body on what should be done to resolve them.

Although, strictly speaking, these views are only advisory to the NRC, they must be considered by the Commission and by its staff. In addition, they are noted in the technical press and studied carefully by other applicants and by the architect-engineer firms and reactor vendors who are responsible for designs.

The importance and the influence of the ACRS stems partly from its Congressional charter and partly from its independence and its expertise. Many of the safety-related questions that have required extensive study by the NRC staff and the nuclear industry have first been raised by the ACRS. Its views on reactor safety are recognized as being conservative and concerned primarily with the health and safety of the public.

I have provided a somewhat detailed explanation in my written testimony because any added responsibilities assigned to the ACRS in the review and evaluation of DOE nuclear facilities and activities will be limited by the available time of the members, the available expertise of the members, and the available technical support.

The first limitation is time. Currently, the ACRS members, who are part-time, special government employees, are devoting on the average some 130 days per year to ACRS activities. I point this out to indicate that there are limitations as to the amount of additional review activities that the ACRS can effectively handle.

The second limitation is expertise. Most of the expertise of the ACRS is in disciplines related to nuclear power plant safety and nuclear waste management. We do have available to us a number of consultants that augment our capabilities, but if our role is enlarged to include activities greatly different from what we are currently doing, we might be faced with finding members and consultants with different expertise. It is for this reason that our review of activities such as weapons testing and enrichment plants would not fall within our purview of expertise.

The third limitation is that of available technical support. We have a small internal professional staff and, as previously indicated, we rely on the NRC staff to perform thorough and detailed technical analyses of the projects that we review. Reviewing an analysis is greatly different from performing the analysis.

We believe we can be more effective by questioning the assumptions, standards, the analytical procedures used and the results obtained rather than performing the analyses ourselves.

As the NRC staff will not be involved in the review and evaluation of DOE nuclear facilities, we will need similar support from the Department of Energy. This could be a substantial DOE effort if DOE does not now have a group that similarly performs in-depth technical safety studies and analyses.

The additional resources that would be required are very dependent on both the type of our review and the number of reviews that we do. I believe that the ACRS can, with some modest increase in its staffing level and funds, undertake a limited number of reviews of DOE facilities. Review of two to four DOE facilities per year appears reasonable. The additional resources required can be better determined after the number of the type of reviews are better developed.

In summary, I wish to indicate that the ACRS will gladly expand the scope of its operations to include a limited number of reviews of DOE nuclear facilities and activities, if it is the desire of Congress that we do so.

Such reviews and evaluations should be restricted to areas of our general expertise involving nuclear reactor safety and radiological waste management. Substantial technical support from DOE will be required and some increase in our internal staff and funding support would be required.

Chairman **GLENN**. Thank you very much, Mr. Remick. You talk about relevance, technical expertise, resources needed, and whether ACRS could accept an assignment such as this, and those are all good things to bring up.

In your testimony, I believe you made the distinction between reviewing analysis and performing analysis.

Mr. **REMICK**. That is correct.

Chairman GLENN. And you have had a background, a history with NRC of having a staff there to do that kind of analysis for you, and then you could review it and authenticate its adequacy, I guess.

Mr. REMICK. That is correct.

Chairman GLENN. My question is, to your knowledge, does DOE have a group that now performs in-depth technical safety studies and analysis? Is ESH satisfactory for that or would something else have to be set up if you were to take on this task?

Mr. REMICK. I am not knowledgeable of the strengths or weaknesses of ESH. I do know that at many of the sites, at the contractor sites, there is a lot of expertise at those facilities like Savannah River, INEL, Argonne and places like that.

My guess would be that the DOE at the headquarters does not have the strength of the NRC in its analytical capabilities in reactor safety, but I cannot say firsthand that I know what they do have.

Chairman GLENN. Mainly in that the ESH is of more recent vintage; it has not been around as long?

Mr. REMICK. That is correct, and I think they never had that central responsibility; that it was pretty well at the reactor sites where the expertise in designing and construction of operation of those specialized facilities was at the DOE locations rather than in Washington.

Chairman GLENN. Well, I am complimentary to DOE for at last setting up the ESH system over there, and I think that could probably be developed into something akin to what you have worked with at NRC as far as the technical analysis goes, or at least I would hope it would be.

Mr. REMICK. I would think that that would be most appropriate and that would serve as a nucleus of what would be needed.

Chairman GLENN. Yes. In your testimony, you mentioned the memo of understanding that exists between ACRS and DOE concerning criteria and practices for DOE requests for ACRS review.

Is there anything that would need to be expanded in that MOU before you could go ahead with an assignment?

Mr. REMICK. I think that if we were to take on expanded assignment that there would be some things that would have to be negotiated between DOE and the NRC, and they would be such things, I would think, as who handles budgetary requests.

There would be a lot of administrative details, I think, of two organizations working together that might have to be expanded upon. I think the basic document for the use of ACRS for its technical expertise is there, but I think the two agencies would have to get together and discuss, perhaps elaborate more.

Chairman GLENN. You also talked about the ACRS review of the N Reactor at Hanford, of particular interest to my colleague here to my left, and the reactors at Savannah River.

Could you tell us more about the findings of your reviews of each of these facilities, how many of them you did, how much time it took, or how extensive it was?

Mr. REMICK. Of course, this goes back primarily to the time before there was a split from the AEC to the NRC and ERDA, and then ERDA to DOE. We can provide you with numbers. I do not have them at my fingertips.

But there were extensive reviews at that time and the findings were, realizing that these facilities were specialized facilities important to the national defense, pointing out that they did not have containment, and so forth, they thought, however, that they could be operated safely at that time, but we are talking about a time ten years ago or so when the ACRS last looked in depth at those particular facilities.

Chairman GLENN. When you looked at Savannah River or at Hanford, is there any way you can compare your ACRS review of these reactors with the reviews conducted by DOE?

Mr. REMICK. No. I did see recently the audit report that DOE conducted at Savannah River and I think that was an in-depth audit. I was impressed with some of the expertise they had and some of the recommendations they made were consistent with my knowledge.

So, based on that one very recent—and I think that is within the last month—audit, I was impressed with that. But that is not the type of thing that ACRS does. ACRS looks more—it is not out in the field conducting an audit, going through the plant and pointing out that your fire safety is not adequate to protect your firemen, and so forth.

It is more an overall analysis or review of your analyses of reactor safety, what criteria you use, your organization, your training of your personnel, what standards are you using, and so forth.

Chairman GLENN. Was this ACRS review in sufficient depth that it would have been a document or a study that you could have used, then, for your review?

Mr. REMICK. The DOE audit that I am referring to?

Chairman GLENN. Yes.

Mr. REMICK. Yes.

Chairman GLENN. In other words, the work that was done at Savannah River and at Hanford, you said that it looked like a very credible piece of work.

Mr. REMICK. Yes.

Chairman GLENN. Is that something that was in sufficient detail that if ACRS had had the job of overseeing this, that would have been in sufficient detail that you could have made judgments as to its adequacy?

Mr. REMICK. Yes, I think so. If that had been done by the NRC on a licensed facility, ACRS would automatically have gotten copies of it and we would have gone through that. And, yes, I would have found that document to be adequate for the ACRS to determine if it needs to look into this further.

Chairman GLENN. The history of the ACRS is you were heir to the expertise of the blue ribbon advisory group that was known as the Reactor Safeguard Committee, and that committee took a conservative and respected approach.

It is what its chairman, the physicist Edward Teller, called a simple procedure, as he put it. He said for each reactor, he had asked the designers to, as he put it, imagine the worst possible accident and to design safety apparatus guaranteeing it could not happen.

Now, the Committee reviewed each reactor plan trying to imagine an accident even worse than that conceived by the planner. "If we could think of a plausible mishap worse than any discussed by the planner, then his analysis of the potential dangers was considered inadequate."

Is that still the essence of the ACRS philosophy?

Mr. **Remick**. Yes, it is very much the ACRS philosophy.

Chairman **Glenn**. Brock.

Senator **Adams**. Thank you.

One of the issues, Mr. Remick, that has been raised in the Roddis report—and given your experience with commercial facilities, what are the key factors that should be considered, and how should they be considered, since there is not any NRC licensing review of these production reactors like the N Reactor?

What criteria and determinations about when it should be terminated or when another should be started need to be developed, in your opinion?

Mr. **Remick**. If I understand your question, the question of when do you phase out existing production reactors and when do you replace them with new ones is something that I know a discussion has been happening on, and different alternatives—consideration of a new production reactor at Savannah River or perhaps one in Idaho, or the use of one of the WHPS reactors in Hanford, and so forth.

I think it comes down—and I do not claim to have expertise in that—it comes down to more of a military need, which I do not have any knowledge of, and the question of national resources.

There is no question that a new production reactor would be extremely expensive, but the question of when it is needed, and so forth, I honestly cannot answer because I do not know the military need.

Senator **Adams**. One of the questions is that if we are going to have criteria as we do with civilian reactors, can we really depend upon the agency itself which is involved in production to conduct review of both safety determination of when their useful life is over and such things as waste disposal.

Mr. **Remick**. I do not want to belittle the competence or the ability or the integrity of the Department of Energy. There is no question about that, and good people can do good things if they are determined to do it.

But I think it is always good to have an independent body which does have the responsibilities and the pressure of the production taking an independent look at what you are doing when safety is involved. As a general principle, I always feel that it is good to have outside expertise looking at what you are doing and asking difficult questions.

Senator **Adams**. My last question is that you indicated that it has been really ten years more or less, since the division came out of the old AEC and later ERDA, and so on, since you had looked at these reactors and you were balancing military needs against whether or not it could be operated.

At that time, was any determination made of the period of useful life or a set of criteria established as to the status of these reactors, how long they would be in a condition that you felt, having looked at them, that they could be continued?

Mr. **Remick**. I honestly cannot answer that. I was not a member of ACRS at the time, so I am not familiar with the reviews and what they found. I do know that at the N Reactor and Savannah River in more recent years, they have independently looked at their own reactors and produced safety analysis reports for their facilities, trying to see if they were comparable with NRC licensing standards.

And in all honesty, no; they were designed for a different purpose under different needs, under different pressures, and so forth. So I think, in all honesty, they do not meet NRC licensing requirements.

But they have made that study to try to adopt NRC standards to the extent possible, but they certainly have not reached that and I know that there are efforts at places like Savannah River to become familiar with what the commercial industry is doing, what the Institute of Nuclear Power Operations is doing, and to look at adopting some of those best practices.

But I think you will never see the time when those old facilities can be modified to meet current NRC standards. I would presume if there was a new production reactor that it should come more close to meeting those standards.

Senator **Adams**. Thank you, Mr. Remick. Thank you, Mr. Chairman.

Chairman **Glenn**. Thank you, Senator Adams.

I do not really have any additional questions now. We may submit some to you later on and Committee members may wish to submit some additional questions. We would appreciate your replying to those as expeditiously as possible, and thank you for being here this morning, Mr. Remick.

Mr. **Remick**. I appreciate the opportunity to do that.

Chairman **Glenn**. Thank you.

Our next witness is Mary L. Walker, Assistant Secretary for Environment, Safety and Health, U.S. Department of Energy, accompanied by Don Ofte, Principal Deputy Assistant Secretary for Defense Programs, U.S. Department of Energy.

Welcome to our hearing this morning. Thank you. We have had a great deal of discussion of DOE this morning, and some of our ideas and proposals, and so on. We welcome your testimony this morning, and either a summarized version thereof or whatever, and in any event the total statement will be included in the record.

TESTIMONY OF MARY L. WALKER, ASSISTANT SECRETARY FOR ENVIRONMENT, SAFETY AND HEALTH, U.S. DEPARTMENT OF ENERGY, ACCOMPANIED BY DON OFTE, PRINCIPAL DEPUTY ASSISTANT SECRETARY FOR DEFENSE PROGRAMS, DEL BUNCH, DEPUTY FOR SAFETY, HEALTH AND QUALITY ASSURANCE, AND ROBERT MORGAN, OPERATIONS MANAGER, SAVANNAH RIVER PLANT

Ms. **Walker**. Thank you, Mr. Chairman, and thank you for the opportunity to testify before this Committee on the Department of Energy's——

Chairman **Glenn**. Before you start and before I overlook this. Senator Heinz was here and could not stay because of another hearing. He had a statement he wished to have entered in the record. Without objection, it will be entered in the record following that of Senator Roth.

Proceed.

Ms. **Walker**. Thank you for the opportunity to testify this morning on the Department's reactor safety program. Accompanying me, in addition to Mr. Ofte, is my Deputy for Safety, Health and Quality Assurance, Del Bunch, who was formerly with the NRC reactor licensing office.

Today, I will be presenting a status report on the safety of DOE's nuclear reactors and several specific issues of interest to the Committee, as well as my current views on ways to provide continued improvement of the Department's system.

I will not attempt to read my entire statement, but would like to highlight portions of it for you.

Chairman **Glenn**. The entire statement [6] will be included in the record, if you so desire.

Ms. **Walker**. Thank you; I do.

When Secretary Herrington came to the Department of Energy two years ago, he found that a much stronger environment, safety and health oversight (ES&H) activity was needed in order to increase our confidence in the safe operations of DOE's facilities.

In response, he immediately made the strengthening of this function one of his highest priorities. The initiatives he announced in late 1985—the formation of my office, the technical safety appraisal program, the environmental survey of DOE sites, and a more systematic tracking of compliance—are the foundation of a still expanding environment, safety and health program in the Department.

These comprehensive initiatives were designed to establish baseline information on the environment, safety and health conditions of our facilities and sites and to develop recommendations for improvement, not striving for merely compliance but for excellence. Accordingly, we are now making fundamental changes in the areas of standards and orders and the ES&H oversight system of the Department.

Over the past year, concerns have been raised by the Chernobyl accident and have focused considerable public attention on the safety of all reactors in this country, including those, of course, of the Department of Energy.

Even before that accident, however, we had begun the multi-disciplinary safety examination of all of our high and moderate-hazard nuclear facilities under the technical safety appraisal program.

In February of 1986, my office conducted the first in a series of reviews of these facilities. A thorough, multi-disciplinary review was performed of the safety aspects of the Fast Flux Test Facility at Hanford. Some areas for improvement were noted, but basically the operation did receive good marks by the review team.

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[6] See p. 128.

After the Soviet incident, Secretary Herrington called for additional reviews by my organization not only of the N Reactor, but of other reactors, and he asked for us to look at the specific issues raised by the incident. He requested an additional review of the N Reactor by six individual consultants, one of whom, Mr. Roddis, has already testified here today.

We have since reviewed the three operating production reactors at Savannah River, as well as the N Reactor, and we are in the process of reviewing the Oak Ridge High-Flux Isotope Reactor at this time.

Secretary Herrington has also requested a review of the Department's Class A reactors by the National Academies of Science and Engineering. That review is ongoing and I am anxiously looking forward to their recommendations.

The reviews by my office have been thorough, and pursuant to the Secretary's objectives, the review teams have focused not just on compliance, but safety excellence. Our review teams consist not only of my ES&H senior managers, but also the majority of the teams actually consist of outside experts recognized for their experience in specific areas that are reviewed pursuant to the initiative.

The Department's commitment to surface publicly our detailed safety assessments, to use recognized outside experts on our teams, and to provide detailed plans concerning the implementation of the recommendations reflect our intent and the Secretary's personal commitment that safety at DOE be an open process.

Our reviews have identified problems and areas where we can and should do better. We expected that. That was precisely the Secretary's intent. I hope to discuss with you further the significance of some of our findings and the safety process that is required by DOE's official management policies or orders.

Concerning the Department's safety analysis and review system, a specific issue of interest to you personally, I know, Mr. Chairman; at your request the GAO has reviewed the safety analysis program for selected nuclear facilities of the Department.

Their report, dated June 1986, contained four recommendations for improvements to the Department's safety analysis program. We concurred with three of the four findings and recommendations and took immediate action to respond to GAO.

First, to assure timely completion of the safety analysis reports for our high-hazard facilities, my Office of Nuclear Safety is tracking the progress of those reports which are not yet finalized, and it is my understanding that all of the high-hazard facilities will have approved safety analysis reports by the end of this fiscal year.

To assure that the safety analysis reports can be readily compared to the current Department design criteria, we have prepared a revision to the DOE orders requiring such an analysis be performed.

To assure consistent requirements are being followed in the preparation of these reports, updated and improved guidance from my office will be provided and the safety analysis reports for selected DOE nuclear facilities, including the high-hazard facilities, will be reviewed independently by my office.

The fourth recommendation called for an outside review on all safety analysis reports. My office, however, is already independently reviewing the safety analysis reports of these high-hazard facilities, and in these reviews we make extensive use of outside technical experts who have specialized knowledge of the operations and technologies being reviewed. Accordingly, we believe an additional layer of review at this time of the safety analysis reports is not warranted.

On the issues of safety standards and comparability with the commercial sector; as you know, DOE establishes safety requirements through the issuance of its DOE orders, which are binding on the contractors operating our facilities.

These safety requirements are periodically revised to reflect evolving national and international standards. As a policy objective, the Department seeks to apply codes and standards that are consistent with those of the best-accepted practices. These are determined by regulatory agencies such as NRC, OSHA, DOT and FAA, and national and international standards-setting bodies such as the American National Standards Institute and the American Society of Mechanical Engineers.

Given the specialized nature of DOE's reactors and our facilities, the application of these requirements and guides on a one-to-one basis is often inappropriate. DOE requirements, therefore, have emphasized what safety performance must be achieved rather than prescriptive "cook book" requirements as to how safety programs are to be implemented.

NRC, which has a prescriptive requirement system, has an arm's length relationship with its licensees and can only require actions for which there is authority under law. DOE, on the other hand, with its performance-based system, can more effectively address and correct the root causes of problems.

Indeed, through nuclear safety research performed by DOE laboratories and our research facilities, DOE routinely provides NRC with data and expertise in developing its standards.

In short, DOE is not just another nuclear operator, but rather is a key element of the government's program to ensure the proper development and safe operations of nuclear facilities.

Recently, safety reviews, my own office's included, have raised questions regarding the degree of comparability which should exist between DOE and NRC practices. These reviews have also found instances where the Department's standards have not been sufficiently defined or interpreted to assure their effective implementation. This is the downside risk to a flexible, performance-based system.

Recognizing the advantages to DOE's system, but responding to the need to avoid this downside, I have established a new Office of Safety Policy, whose primary function is to examine DOE's safety policies and requirements and to assure their completeness and comparability with the commercial sector.

Also, my Office of Nuclear Safety has implemented a program to develop more definitive requirements and guidance for nuclear facilities to assure that accident risk is minimized.

How well has our safety system worked? Well, we believe the basic system has been effective, although recent facility reviews under Secretary Herrington's initiatives have indicated that shortcomings have arisen over time that now require attention.

During the 14 months of my tenure as Assistant Secretary, my office has performed the following safety reviews—there are, of course, additional reviews on the environmental side, but today I am highlighting the safety reviews for you—13 technical safety appraisals; 3 quality assurance appraisals; 12 reviews of new projects; 25 reviews of Type A and B accident investigations; 22 occupational safety and health appraisals, including multi-discipline approaches such as fire protection, industrial hygiene, transportation, and other areas; 10 nuclear safety functional appraisals, which include functions such as reactor safety, health physics, emergency preparedness, and quality assurance; 2 management appraisals; 3 design reviews; and 4 special reviews, including one pertaining to N Reactor at Hanford.

Based on these reviews, I am developing a good sense of the strengths and weaknesses of the DOE system. Although one strength continues to be the Department's record in terms of its safety statistics, which in many instances exceed those of the commercial sector, as I said, these appraisals and reviews have identified areas for improvement.

For example, some primary areas we have found: First, there is a need to more formally implement occupational training programs at some of our facilities. Secondly, health physics practices in certain operational areas such as instrumentation need to be upgraded to be consistent with industry practice. Thirdly, at several sites, substantial upgrades in fire protection are being implemented in accordance with recommendations resulting from our appraisals.

With a systematic appraisal tracking system now in place, another Secretarial initiative, corrective actions will be closely monitored by my office to assure they are timely and responsive.

A number of options are also being considered by us at this time to further strengthen the improved safety system, including the additional use of outside sources of safety expertise.

We believe the use of review organizations especially tailored to meet the needs of the DOE complex, such as an organization tailored after the utilities' Institute of Nuclear Power Operations, or INPO, for our contractors, and a group to provide external advice and oversight of DOE safety assurance, for example, by an organization with functions similar to the Advisory Committee for Reactor Safeguards, could serve to strengthen or augment the existing system without compromising it.

I have had conversations with members of both INPO and the ACRS on the expertise that they may continue to provide us and I will continue those discussions in the next few months.

As I have testified before, we are keeping an open mind on this issue and will support any initiative that will build on what has been accomplished and will, in the end, provide better safety assurance.

In conclusion, then, we recognize that even with recent strides the Department has made in safety under Secretary Herrington's leadership, much work remains to be done. We believe our safety oversight system for nuclear facilities is basically sound, but it can be improved.

The individuals and organizations charged with conducting independent reviews need to assure a higher degree of independence from programmatic influences, and the appraisals of contract activities need to be more penetrating and more challenging.

The issue of aging nuclear facilities is one that NRC and the nuclear utilities are just now starting to face. Our safety reviews have focused on ensuring that these reactors and other nuclear facilities will be operated well, in an acceptable manner, and by knowledgeable and well-trained staff.

While acknowledging that DOE faces some tough questions on whether to continue to operate these facilities or replace them, I want to emphasize to this Committee that my job is to determine if they are being operated with an acceptable level of safety.

The Department has also taken note of the lessons of the *Challenger* accident and the Chernobyl accident. We are——

Chairman **Glenn**. Ms. Walker, I am going to have to interrupt because we are on five lights on a vote and we just have a few minutes left to get to the floor to vote. I am sorry we have to break, but we will get back just as fast as we can. I was trying to let you wind up here, but we are down——

Ms. **Walker**. I am almost done, anyway. That is okay.

Chairman **Glenn**. We are really down to the short rows. We will be back as fast as we can get here.

[Recess.]

Chairman **Glenn**. The hearing will resume.

Do you want to finish up your statement here?

Ms. **Walker**. If I might, Mr. Chairman, I only had a sentence left, I believe.

Chairman **Glenn**. All right, good.

Ms. **Walker**. As I was saying, this Department has taken note of the lessons of the *Challenger* accident and the Chernobyl accident. We are acutely aware of the continuing need to be vigilant and to instill a safety-first attitude throughout the Department and its contractors.

We do not want our contractors to be merely satisfied with minimally acceptable practices. We will be looking to them to strive for excellence.

I want to thank you, Mr. Chairman, and the rest of the Committee for your attention and I would be pleased to answer any questions.

Chairman **Glenn**. Thank you very much, and I apologize. We had a rather truncated hearing here this morning, but that is the way it goes.

Let me ask first about your action with regard to Savannah River. I am concerned about the timely reaction to some of these things, comparing how ACRS and NRC work together and how DOE operates.

We have had some problems that we discussed earlier this morning about the C Reactor at Savannah River. At what date did you first learn about the cracks in the C Reactor and what action did you take at that time?

Ms. **Walker**. I have to ask, I believe, either Mr. Ofte or Mr. Morgan, the operations manager, to tell me when they first learned of this—as long as I can recall, my office was aware of the C Reactor cracks. I believe they have been known for at least as long as I have been with the Department, and it has been down and they have been examining them.

I had people from my own Office of Nuclear Safety on the site to review what was being done and to look at the analysis being made of those cracks. Of course, my main concern was that the reactor not be brought up to power until such time as the cracks were understood, repaired, and to everyone's satisfaction an adequate level of safety was being provided.

The reactor has remained down, and so I have been satisfied that pending those questions ultimately being answered, we are taking appropriate action at this time. But the early history of that issue, I was not involved in, so——

Chairman GLENN. Well, what happened at DOE now? Maybe one of the other gentlemen could answer that.

Ms. WALKER. I think I am going to need Mr. Morgan, the operations manager for Savannah River.

Chairman GLENN. All right.

Ms. WALKER. If I could ask him just to step forward.

Chairman GLENN. Well, now, did DOE at the headquarters take any action or did you leave it up to the people operating at Savannah River?

Ms. WALKER. Well, no. As I indicated, first of all, we have performed a technical safety appraisal of the production reactors and I have had people from my Office of Nuclear Safety on site at various times over the last several months to review what is being done and to be looking along with them on that issue.

So we have not relied solely on the field organization or the program for that. I do not believe the analysis has developed to a point yet where we are involved in a decisionmaking mode. It is really one of staff level discussions from a technical standpoint.

Chairman GLENN. Okay. What action was taken at Savannah River when the cracks were discovered?

Mr. MORGAN. We shut down the reactor, sir.

Chairman GLENN. Okay, and what then determined that it would be safe to bring them back up, or are they still down?

Mr. MORGAN. The C Reactor is down, sir.

Chairman GLENN. It is still down.

Mr. MORGAN. It is of different construction in the vessel than the other reactors. The other reactors have no indication of cracks. We first have to determine a repair technique.

The repair technique that we used in 1968 when we had leaks in that same vessel earlier would not work when we attempted them in the C Reactor, and we do not have today a repair technique that we are satisfied with, sir.

Chairman GLENN. Okay. On the ultrasonics, you have not used ultrasonics as is required in the regular commercial reactors, is that correct?

Mr. MORGAN. That is correct, sir.

Chairman GLENN. Do you plan to do that?

Mr. MORGAN. There is consideration for that being done, sir. We have a low-temperature, low-pressure reactor vessel that is approximately half an inch thick. There are not the stored energy and leak propagation problems or the energy stored that will cause a different problem in a commercial reactor.

In our safety analysis report, we can tolerate a leak; we can detect the leak, and that is how we detect—we did not find the cracks in the C Reactor by dye penetrant. We found it because it had actually penetrated the vessel wall, and we have a system that collects the vapor that came out and we detected it in that way. In other words, it leaks before there is a break.

We shut it down when we got leak rates, sir, and then found the cracks later.

Chairman GLENN. Would that always be the case?

Mr. MORGAN. Yes, sir.

Chairman GLENN. It would seem to me if you are getting to a crack that was causing a leak, you would be getting pretty far down the line toward an imminent failure. Is that not correct?

Mr. MORGAN. This is basically atmospheric pressure, sir. It is not a high-pressure machine, and all analysis that we have conducted on the material—it will leak and yield and it will not have a catastrophic break-out. So we were operating under our safety analysis report, sir.

Chairman GLENN. We may want to ask some more questions for the record on that. We would appreciate your responding to them, but I have been very concerned that safety is not sacrificed to production, which has been one of our big problems, and I presume that is your goal, also.

Mr. MORGAN. May I assure you, sir, that we are not going to sacrifice safety for production. If I were not to meet a production goal, I am not going to be removed from my position. If I were to violate safety in order to make production, I would not be here today, sir.

Chairman GLENN. Well, okay, and I hope that is the way things are being looked at across the whole Department of Energy now, because in the past I do not believe that has always been true. Production goals have taken precedence in the past too often over safety concerns, and we have run into that repeatedly in some of our review of past records, some of the efforts that got me into this to begin with back at Fernald in Ohio.

We should have had far greater concern for safety for the people working there and the community than was evidenced. Well, we are moving now to correct some of those things. But if we did not have this past history within DOE of being a little negligent in this area, considerably negligent in this area, then it would seem to me that we would not even be here today, but that is what this is all about.

So I hope that DOE has gotten the message that we are not going to sacrifice any health to production goals, as my opening statement indicated.

Let me ask, Ms. Walker, do you feel that DOE facilities could be licensed by NRC, by their standards?

Ms. WALKER. Well, to my knowledge, at the current time, given the differences in the facilities and the unique aspects of some of our production facilities, I do not believe that a match on all of NRC's requirements could be made.

But I would like my deputy, Del Bunch, to speak to that, since he was formerly with NRC's licensing group.

Mr. BUNCH. Sir, the new reactors that would be built under the Department of Energy would basically have to conform to the same type of criteria as would the NRC's reactors, the most recent one of which was the Fast Flux Test Facility in Washington which was extensively reviewed by the Nuclear Regulatory Commission staff and by the Advisory Committee on Reactor Safeguards.

Based on that review and the kind of standards we impose now for new reactors, I am quite satisfied that the Nuclear Regulatory Commission would find that the kind of facilities we build would meet their criteria.

Chairman GLENN. Well, two qualifiers there. Those are not production reactors that you are talking about, and you are talking about "will be built." I am talking about existing facilities.

If NRC came in and said that they were putting their criteria to it, would they permit them to continue operating? Would they license them right now? That is the question.

Mr. BUNCH. Well, sir, the criteria that are used for older facilities are not the criteria that they would use on a brand new facility today. The NRC takes the facilities as they find them. They have a process of looking at older facilities and trying to cause them to be upgraded, where it makes sense to do so.

Even though they might be perfectly acceptable 20 years from now, they see if there are ways to improve the safety. We do the same, so that they and we both use a rule of reason in looking at facilities which were built in a different era.

Chairman GLENN. Well, okay, but let me put it a different way, then. If NRC came into the DOE plants now, would they say shut them down or would they say go ahead, they are safe to operate under NRC criteria?

Mr. BUNCH. I think they would try very hard not to jump to a hasty conclusion and they would probably ask——

Chairman GLENN. That is not the answer to my question. Would they license them or not?

Mr. BUNCH. The older facilities would not meet current-day standards, nor would some of the older NRC-licensed facilities. So we are not talking about trying to come up with a license at all.

What we are trying to see is whether or not they would find the state of safety of those older facilities adequate to meet their requirements.

Chairman GLENN. Well, it has been our impression—and I will answer my own question, I guess—it has been our impression from what the staff has done here and what GAO has done that we have set two different standards, one for DOE to operate production facilities across the country, and quite another that we expect commercial facilities to come up to different standards.

I do not think we can afford different standards any longer. It is safety and health of our people and workers, and that is just as much a hazard from a DOE plant as it is from an NRC plant.

If we have the capability of making the plants more safe, then that is exactly what we have to have done. I think in the past, as I said, safety has been sacrificed to production too often, and that is what we are trying to correct here and that was the reason for my question.

What are your concerns, Ms. Walker, concerning outside independent safety reviews? I gather you do not favor them, is that correct?

Ms. WALKER. Well, I am not sure that is what I said in my opening statement. I think I would like to expand a little bit. First of all, I am not opposed to the use of outside experts or having them look at our facilities from a generic standpoint.

In fact, when we designed the Technical Safety Appraisal program, we not only designed it after INPO's model, we went beyond what INPO requires and does and we have the majority of our teams consisting of outside experts. The same is true in the Environmental Survey.

In addition to that, we have used outside groups, such as the independent Roddis group and the National Academy group, where we feel they can contribute and where we would like them to look at specific facilities or issues for us.

As I indicated to you, my charge from the Secretary has been to review not only the changes he has made to strengthen my organization, but what further can be done to leave a legacy of a very strong safety oversight within the Department of Energy.

Among the options my office is currently reviewing, especially my Office of Safety Policy, the new office, is the increased use of outside groups such as ACRS, INPO, and I have opened discussions with those groups, as I indicated, with some of their individual members as to what expertise they have, what their limitations are.

They have clear limitations in some cases and do not feel comfortable looking at some of our facilities. In other cases, they really feel they can contribute. So we are exploring that.

Chairman GLENN. Well, take the NRC–ACRS model, and what has been wrong with the way NRC and ACRS have operated? It seems to me that has been a pretty good pattern to follow. You obviously did not have all the internal expertise. You called in Mr. Roddis and his group and the National Academy of Sciences.

What is wrong with making that a permanent function so that we have ACRS doing this?

Ms. WALKER. I am not saying there is anything wrong with that. It may be appropriate. As I indicated in my testimony, one of the things we are looking at is the consideration of an ACRS-type group for the Department of Energy specifically tailored to those kinds of facilities we have, and that may be a very good idea for the Department.

We are not limiting ourselves to just that option. As I indicated, we are also discussing things with INPO and considering other methods. So I am not opposed to that. I am saying we are keeping an open mind, we are looking at this.

Whether we would use something like an ACRS-type group or ACRS itself would depend on the functions that that group could perform and what really the needs are. As I indicated, we are trying to build on what Secretary Herrington has already done, and so we are looking at these options and others.

Chairman GLENN. What role did the Roddis Panel conclusion play in shutting down the N Reactor?

Ms. WALKER. None.

Chairman GLENN. None? You would have shut it down anyway?

Ms. **Walker**. I think so. What happened was I had—let me qualify "none" by saying I think we would have done it anyway, but obviously I took their recommendations as well as my own.

I had over 30 independent experts looking at the N Reactor for me. I had three different reviews. I had a design review, a technical safety appraisal, and a special review on the fire protection and the graphite issues raised by Chernobyl. In addition to that, the Roddis group made its own recommendations.

Chairman **Glenn**. If you had 30 experts out there looking at it, why did you call on Mr. Roddis?

Ms. **Walker**. I think the Department and the Secretary wanted to have a group of people that were recognized as experts, in an atmosphere of charged public emotion, look at that particular facility to assure them that Chernobyl could not happen there, or if it could, to prevent it.

Chairman **Glenn**. Right.

Ms. **Walker**. But we do not have Chernobyl's every day of the week.

Chairman **Glenn**. I agree with you 100 percent, but I think what we have come to now is a new indication that we do have a creeping Chernobyl, if you wish. We have a danger here. We saw that we operated down at Savannah River six or seven years with inadequate core cooling. We finally made an adjustment on that.

I think if we can just prevent that happening one time with an outside group—I know no one likes people looking over their shoulder when you have production schedules to be met. We ran into this at Fernald. We ran into a bad situation that is now being cleaned up, and this was DOE.

Now, maybe you have got it under control, but what on earth is wrong with having an outside group come in and look over your shoulder? I think the Roddis Panel had a big impact on you out there, whether you want to say so or not.

Ms. **Walker**. Well, I have to say, and I think it is borne out by the record, that the Roddis Panel did not raise any issues not found by the three safety reviews performed by my organization.

Chairman **Glenn**. Okay, but what you were pointing out was there was a big public perception here, and that is what I am pointing out. There is a public perception now that DOE in the past, at least—now, maybe the current watch is doing a great job, I do not know, but the perception is that it has been neglected for too long.

What is wrong with reassuring the public with an outside group that can look over your shoulder and give you a stamp of approval? That is what we have at NRC and it works well. I see nothing wrong with having concern with that kind of public concern, which you had after Chernobyl, so you called in Roddis, an outside group of experts, to give the stamp of approval to what we are doing; fine.

Let us do the same thing throughout the whole DOE structure. That is all we are saying.

Ms. **Walker**. And basically, Mr. Chairman, I think the Department has already taken steps along those lines, in keeping, as I said, with its desire to include outside groups, where it makes sense, such as the National Academy.

They are looking at all the major reactors; not just production, but also the other Class A reactors of the Department, and we are expecting that review to be thorough and comprehensive.

As I indicated, we are also looking at other options for permanent groups. So I think we are thinking along the same lines.

Chairman GLENN. Do you lack money to do the job you want to do?

Ms. WALKER. My own office or the Department?

Chairman GLENN. The whole works.

Ms. WALKER. For the whole works.

Chairman GLENN. Yours, in particular.

Ms. WALKER. I will say, first of all, that the Secretary and the Administration have, in every case where we have asked for resources since the Secretary got there, backed that request and asked for those resources. In some cases, Congress has given us less than we asked for.

Chairman GLENN. Congress or OMB?

Ms. WALKER. Congress.

Chairman GLENN. OMB has never cut your budget?

Ms. WALKER. I do not believe OMB has cut our requests for environment, safety and health, but we have had some reduction by Congress in what we requested. That is not to say that the increase since I have been there has not been significant; it has.

The increase in my staff has been 50 percent in a year-and-a-half; it has been 60 percent in dollars. So the increases have been significant in my office, and the Department's commitment to environment, safety and health has also increased significantly.

I think the environment, safety and health protection measures are now up to something like $2 billion in the fiscal 1988 request.

Chairman GLENN. Did you take a hit on Gramm-Rudman?

Ms. WALKER. I think the whole Department and the whole federal government made some cutbacks as a result of that.

Chairman GLENN. Was your safety budget cut as a result of Gramm-Rudman?

Ms. WALKER. No, I do not believe—well, I do not believe so.

Chairman GLENN. It was not? It was supposed to be passed along to every single entity within the Department. If it was not, I do not know how you got by with it. You violated the law, then, or somebody over there did.

Ms. WALKER. I guess what I am saying is my office continued to increase in resources, although the initial agency request may have been decreased as a result of Gramm-Rudman.

Chairman GLENN. Can anybody else answer that? Did you take a hit under Gramm-Rudman?

Mr. OFTE. Yes, sir, we did, in Defense Programs.

Chairman GLENN. And that just shows the fallacy of Gramm-Rudman. We are talking about safety and health for the people of this country. We are talking about radiation, aquifer levels, and you are the people overseeing it and we cannot make a judgment on that because we passed this across the board. I think it is so stupid.

Mr. OFTE. But having said that, Mr. Chairman——

Chairman GLENN. That is not a question; that is a statement. Thank you.

Mr. OFTE. Yes, sir.

Chairman GLENN. Go ahead, respond.

Mr. OFTE. We have a cross-cut budget that we try to establish for ourselves, trying to figure out how much is going into environment, safety and health within Defense Programs activities, and in 1985 that was a total of $564 million.

In 1988, the budget that is before the Congress now, our cross-cut indicates $740 million for those activities within defense programs. Now, that is an increase of 31 percent and it is at a time when we are taking a nine-percent cut in our programmatic budget, so that we are fitting this within an envelope of constrained resources. We recognize the need, sir.

Chairman GLENN. I am going to have to go and I am going to turn this over to Senator Adams to terminate here because I have another commitment I have to be at in a couple of minutes here, but let me just say I am very concerned.

I think we have some very basic decisions to be made in the whole nuclear production field. These facilities have been out there for 30 to 40 years, some of them, and I do not know—and I would seek your expert guidance and judgment on this—I do not know whether we are at the time where we are almost to the point where we cannot band-aid some of these things anymore.

We cannot just modernize certain pieces of equipment in some plants and say we now have an absolutely safe plant. We now have different standards, we now have different knowledge of how to control some of these things. We have different equipment to do some of this production with.

It seems to me we have a very basic decision to be made very shortly, and I am very serious in asking your advice on this as to whether we are in for major overhaul of major components of this system, which is going to cost many tens of billions of dollars, or whether we are going to be able to upgrade and band-aid some of these things a little bit, and whether that then will put us in good shape for the next 25 or 30 years. That is a very basic decision.

The N Reactor is one of them. Just the figures that were given earlier this morning here that we started through—$1.2 billion for the N Reactor; $450 million, Rocky Flats; $60 million, Fernald and Mound; $200 million for something else—and that does not even get to the clean-up of what we are doing to aquifer levels and where we let things get away from us back a couple of decades ago and how we clean that up. We are not even sure we have the technology of how to clean some of it up.

But I think we are into a situation where we have to, in the next year or two, make some very, very basic decisions in some of these areas, and you are the people right in the middle of it. You are the ones who are going to have to make those decisions as to what you recommend.

If you are making a recommendation, I hope it is made on your honest feelings of what we need and not on the basis of what may happen to you at OMB and the budget cuts up here on the Hill. It is too important to become a political football, it really is, and I think all of you would fully agree with that.

We may get back to you on some of these things, and I appreciate your being with us this morning here. Although Senator

Adams is not officially a member of this Committee, he is interested in this and I will turn this hearing over to him, and you can terminate it when you get done. I do have another commitment.

Thank you all for being here.

Senator ADAMS. Thank you, Mr. Chairman, very much.

I want to follow up on his questions, but first, Ms. Walker, you testified before the House Energy and Commerce Committee that you, in your official capacity, found that the N Reactor was safe prior to the January shutdown, and that the millions that were being spent on it were simply enhancement.

In taking this position, you appear to dismiss the position taken by Mr. Roddis and Dr. Lewis that the N Reactor represents a hazard that is not allowed for commercial reactors.

In your December 10th, 1986, memorandum to Under Secretary Salgado on the N Reactor, you seem to go even further and specifically reject the principle that DOE should attain the same level of safety as commercial plants. On page 2 you say, "The Department does not require comparability with safety practices for light water reactors in the U.S. or abroad. The reason for this is that the Department must give consideration to the special mission for the N Reactor."

Is it, in fact, the Department's policy, because it was confusing between yourself and Mr. Bunch this morning, that it need not set a regulatory level of safety that is the same as for commercial activities?

Now, this was asked by the Chairman. You answered in a lot of words, but I am asking you again very specifically, is it the Department's policy that it need not set a regulatory level of safety which is the same as that for commercial activities?

Ms. WALKER. I would like to answer your question in a couple of ways, and if I do not answer it directly by the time I get to the end, you let me know and I will come back and give you a clear answer that sort of wraps it up.

First of all, you used the term "safe" and you said that I said that it was safe, and I think that is not quite accurate. What I said was based on the 30-plus outside experts that reviewed the facility in my three reviews, they advised me, both in those individual reviews and in the cumulative analysis they performed at my request, that there was no unacceptable risk posed by the continued operation of the reactor.

They nevertheless recommended that several things be done to improve the margin of safety. They did not recommend that the reactor be shut down, though I asked them that question directly and gave them total leeway to recommend that. They came back and unequivocally said no.

Senator ADAMS. Your experts?

Ms. WALKER. That is right, those experts either on my staff or retained by me in the three reviews.

The Roddis group, the majority of them, likewise agreed. Two of them said you should shut it down, because it poses risks in excess of the commercial sector, unless you find that it is needed for national security.

Now, whether it was needed for national security or not, if it posed an unacceptable risk, I would have recommended shutdown.

Having found it did not pose an unacceptable risk, and the Under Secretary having found it was needed for national security, I did not believe the reactor had to be shut down for safety.

However, I recommended out of an abundance of caution—and this went beyond any of my staff, beyond the technical experts that were retained by me for these reviews—I recommended that the reactor be brought into a stand-down condition to accelerate the safety improvements and, during that time, to avail ourselves of certain technical analysis, such as the probablistic risk assessment, the initial results of which would be had, I guess, by late March, so that before the reactor was brought up we would have the availability of those and be able to assess the risk.

I think that Roddis, in particular, drew different conclusions than we might, given the existing information. He said that the reactor posed risks in excess of those in the commercial sector.

My own staff has advised me that the risks for commercial reactors differ for each commercial reactor and that it is not clear whether he is comparing us to a particular one or all of them, or what, and that that is precisely what the probablistic risk assessment will be reviewing, and we will have those analyses before the reactor is started up.

Based on that, I have confidence in the actions we have taken and I think they are prudent, I think they are conservative, and I think the majority of experts, whether you are talking about my own or Roddis', would agree with that, and I think they have so indicated.

Senator **Adams**. Well, then, let me ask you some specifics on it.

Ms. **Walker**. I was going to answer your question I never got to, which is you asked me if the regulatory level of safety should be the same. I think the words "the same" make it difficult because we have a different system than NRC's, for good reasons. We have different kinds of facilities.

The way I would say it in a layman's term, which is the only way I can say it to you—and I can ask Mr. Bunch or Mr. Ofte to give you the more technical version—is that I think the public is entitled to an acceptable level of safety, no matter what the facility, whether it is government or private.

I think that we should have to make a positive showing of that level of safety and it should be one that assumes no risk that the public would not want to assume, and I think any industrial complex, any activity you manage, poses risk.

Every manufacturing organization, every method of transportation poses risk. What we have done in risk management is to assess those risks and to make a judgment call as to which ones are acceptable and which ones are not.

I think the public is entitled to a base level of safety from all facilities, a level that it decides is proper, and whether or not at some facilities we have a greater margin of safety than NRC or at some they have a greater margin than we do, I do not know if that is a helpful discussion.

What I think is that the public should be entitled to a certain level of safety from every facility and that that should be one that they feel comfortable with.

Perhaps Mr. Bunch can give you a better technical answer if you——

Senator **Adams**. Before you get to the technical answer, and I will accept that in a moment, but you have testified about your safety enhancement program and a number of the recommendations, including the Roddis Panel, that you listened to.

Now, let us just be specific. Are these going to be completed before the N Reactor is restarted? For example, will hydrogen control, as recommended by Mr. Roddis, for example, be implemented prior to start-up?

Ms. **Walker**. The hydrogen monitoring will be; some of the hardware will not be.

Senator **Adams**. Well, if you have not got the hardware, how have you got it?

Ms. **Walker**. Well, it is not as though we did not have any protection systems in place for hydrogen; we do.

Senator **Adams**. I understand, but he made some recommendations.

Ms. **Walker**. Well, he made certain specific recommendations.

Senator **Adams**. For hydrogen control.

Ms. **Walker**. Well, what I am going to say is that he recommended certain specific methods to protect against the hydrogen potential, and we are looking at other methods which we think might be more appropriate and perhaps, in some cases, safer for worker protection.

So we are addressing the issue, though we may choose different methodology for doing that.

Senator **Adams**. But are you going to start it before you do it?

Ms. **Walker**. As I indicated, we are going to start it. The monitoring will be in place; some of the hardware could not be.

Senator **Adams**. So you are going to start it before you do it?

Ms. **Walker**. That is right, before all of the hardware is installed.

Senator **Adams**. Okay.

Ms. **Walker**. And, remember, when I wrote my memo to the Under Secretary, I recommended that certain things be accelerated. I did not say that everything be done, because I had already been assured by the experts that reviewed it that continued operation did not pose an unacceptable risk, even as the reactor was at the time.

Senator **Adams**. Let me ask you a second one. Will the improvements in the emergency and graphite shield cooling water system be completed prior to start-up?

Ms. **Walker**. Let me ask Mr. Bunch to direct himself to specifics because on some of the issues, I do not have as much information as he does.

Mr. **Bunch**. Sir, we had more than a hundred items, many of which dealt with assuring the operators were well trained and that the procedures were developed and followed. What we have asked is all those things that make sure the reactor is run well are in place and completed before the reactor starts back up.

With regard to the specific hardware changes that you just identified, those are accelerated, will be complete by the end of the calendar year, but are not required to be, under our present planning, finished and in place before the reactor begins operation.

Senator **Adams**. So that will not be finished either before you start it up?

Mr. **Bunch**. That is correct.

Senator **Adams**. All right. Will you have completed a level three probability assessment before the start-up?

Mr. **Bunch**. There will have been completed a level one PRA that identifies the strengths and weaknesses of that particular plant and identifies precisely whether or not there are any flaws in that plant.

Senator **Adams**. But you are not going to complete level three?

Mr. **Bunch**. It is my view, sir, that you do not have to do a level three to determine whether or not there are strengths and weaknesses in that design.

Senator **Adams**. All right. Now, that brings me to the central question which the Chairman has asked that we come back. What we are concerned about is that the way the Department is operating is not to determine whether or not it is safe to any set of criteria that anybody can mention, but whether or not risks are such that you will continue on, and this seems to be continuing on into the indefinite future.

Is that not where you are, Ms. Walker, with this? You do not have a set of criteria or are even following a set of recommendations of the Roddis Panel. You are departing from that and still creating your own set of standards to keep them operating.

Ms. **Walker**. Well, I think you raise several questions in that. First of all, before we start a facility or restart a facility, we have a complicated set of standardized procedures that we go through to assure ourselves that the level of safety and the level of risk are acceptable in terms of that facility's operation.

In terms of the things to be done, there are places where the specific technology recommended to address a problem was one that we did not think was the most appropriate, and we had other outside experts, including those on the Roddis Panel, that had their own ideas.

Taken together, we have developed a plan for enhancing the safety of N Reactor that we think is appropriate. It provides for schedules, it provides for a very valuable way of going through from the beginning and assessing some of the risks that still need some further analysis.

I think that that plan is a good one and it is solid, and I think that it is meaningful.

If you are talking about something else, perhaps there is another issue there, but——

Senator **Adams**. Will you have completed it before you start it?

Ms. **Walker**. We never intended to complete all of it before the N Reactor was restarted. We did not think it was necessary to do all of those things.

Senator **Adams**. And that is the judgment of the Department.

Ms. **Walker**. That is the judgment of the Department and the outside experts that it retained, including the majority of the Roddis Panel.

Senator ADAMS. A majority of it, but the chairman of it clearly had a different statement and opinion and series of recommendations, so you have——

Ms. WALKER. Well, I am not sure that is actually correct, and I would not want to speak for Mr. Roddis, but I believe he said if you make an affirmative finding that the reactor is needed for national security, then he would recommend that the recommendations of my three reviews be implemented as soon as possible.

I do not recall that he said that the reactor would be put in a stand-down condition until all of them were completed. I do not believe he took that step.

Senator ADAMS. What we are inquiring about is a very simple proposition. We have a very old and aging production facility that has not been updated. It exists throughout the entire United States and it is being required to produce more and more of both plutonium and tritium.

What we are asking about is what do you have in place to show the public and this type of oversight from the people that are giving you both money and support to show that you have a set of safety standards that are anywhere near close to the commercial standards or that you have met your own standards before starting production again, because production has become an overwhelming factor as compared to what, in the commercial area and in the modern nuclear area, would be considered something that the American public would accept to have operating.

Ms. WALKER. There are several things that I think will assure the public in the process that we have that this reactor or any of our facilities that we have continued to operate can do so safely.

First of all, I would correct you as to the particular question as framed. You suggested that the N Reactor had never been updated. That is not correct. It has been updated continually since it began operation in the '60s. I think that what we are talking about here is——

Senator ADAMS. No, I did not suggest that it had not been updated.

Ms. WALKER. I am sorry. I thought that you had said that.

Senator ADAMS. Things have been done to it. But on your direct point of updating and the NRC licensing, how many commercial reactors do you have operating in the United States without a containment vessel?

Ms. WALKER. Did you want me to answer the remainder of your question before we——

Senator ADAMS. Answer that and then come back to that.

Mr. BUNCH. One, sir, Fort Saint Vrain.

Senator ADAMS. Thank you. Now, please, go ahead.

Ms. WALKER. We have a safety analysis document for each of our facilities that indicates the basis on which it is being operated. In addition, the technical specifications for the facilities and the operating limits for the facilities are made for our facilities based on that safety analysis.

Now, in some cases those are being updated to be formal safety analysis reports, given the late 1970's requirements to do that, and some of those finalized documents have not yet been completed. But we have underlying written safety analysis for all of our facilities, and those specify the operating limits and analyze the accident potential.

I think that Mr. Bunch could elaborate on that in terms of criteria for you.

Senator ADAMS. Mr. Bunch.

Mr. BUNCH. Our Orders to the contractor do provide that we use or attempt to use uniform codes and standards which are consistent with those applied to comparable licensed reactors. You asked a question about are we trying to achieve the same end. I think the answer is yes, in the terms I just framed to you.

In terms of other criteria, we require that our reactors operate under defined technical specifications which use the same rigorous approach and, in fact, cite the requirements of 10 CFR 36. So we use and require the use of the same standards as does the Nuclear Regulatory Commission in making sure the reactor is operated in safe conditions.

Senator ADAMS. Do you have a comparable set of reactors to the N Reactor in the United States operating commercially that you can compare to?

Mr. BUNCH. As I think Assistant Secretary Walker was trying to indicate, there are enough conceptual differences between reactor types in our system and the light water plants that about the only figure of merit that can be meaningfully applied is a probablistic risk assessment.

Those are underway in both the commercial sector and in our own system, and we expect to have the results in hand in terms of N Reactor done this spring. So in a few months we should have a quantitative analysis prepared by competent individuals that can give you an answer to that.

Senator ADAMS. Tell me this: Do you have a set of criteria, and if so, what are they, for determining whether there is an end of life and when it is for the N Reactor and the Savannah reactors, and how will you determine whether those criteria have been met?

Mr. BUNCH. From a safety standpoint, sir, there are identified conditions in the technical specifications that stem from the safety analyses that we do for these reactors. We make sure that the specifications themselves say as long as you are within these conditions, we are reasonably satisfied that you pose no undue risk to the public.

As long as those conditions are not exceeded, then we are not in an end-of-life situation from a safety standpoint.

Senator ADAMS. Well, given the Department's policy to accept additional risk in order to meet production goals, could you extend these end-of-life facilities?

Mr. BUNCH. I would not agree with the premise. I tried to indicate just a moment ago that the standards we apply—we attempt to use uniform codes and standards which are comparable and consistent with those of comparable licensed reactors.

In terms of changing the criteria to meet some perceived mission of the Department, we have a set of criteria which are a formal part of the DOE system which require the use of technical specifications which are consistent with those of the NRC.

Senator ADAMS. Let me just give you an example of what our concerns are. Ms. Walker, on February 10th, 1987, you informed me by letter that the Department intends to prepare an environmental impact statement on the N Reactor safety enhancement program. The letter stated that DOE was going to proceed with the program during the preparation of the EIS and that the Department would initiate a scoping process after notification to the Armed Services Committee.

What will be the scope of the EIS that the Department will propose with its notice of intent?

Ms. **Walker**. The environmental impact statement will be prepared on the project, which is a safety enhancement plan.

Senator **Adams**. In other words, your own plan; it does not match commercial plans?

Ms. **Walker**. I do not know that that question is meaningful. As I indicated, we have a safety enhancement plan specifically designed to respond to the safety reviews of N Reactor.

Senator **Adams**. Of that old reactor?

Ms. **Walker**. Of course, of that particular reactor, the safety enhancement plan designed to improve the safety at that facility.

Senator **Adams**. How much of your safety enhancement plan will be completed before the EIS is completed?

Ms. **Walker**. It is anticipated that the accelerated portions of the plans will be completed during that time. I can provide the Chairman with a copy of the accelerated plan for the record, and that will document for you all the items.[7]

Senator **Adams**. Would you do that, please?

Ms. **Walker**. I will be happy to.

Senator **Adams**. The final thing is on February 17th, 1987, you replied to a letter from myself and Representative AuCoin to Secretary Herrington concerning our request that your office contact the U.S. Geological Survey to do an independent analysis on the groundwater flow to the Columbia River from the Hanford facilities.

You stated you were going to analyze the final USGS report and it would take you another month to decide on the request. As you know, this has been discussed already with DOE and the DOE contractor representatives.

Now, I have been a former employee of the Executive Branch and I know that decisions take a long time through the process. However, I do think the schedule proposed in your letter is not responsive and I would be hopeful that our respective staffs could get together with the USGS and accelerate this process because we are dealing with a groundwater flow and a waste disposal process there from single-wall tanks that have already leaked into the area.

This plant is only seven miles from the Columbia and we need to know what is happening, so we need to know what your Department intends to do with this.

Ms. **Walker**. First, on that point, it is my understanding that the USGS is performing additional analysis and my staff is waiting for that analysis, and that was one of the reasons for the time period because we are still expecting this further analysis on the points that they were looking at.

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[7] See p. 381.

Secondly, what to do at the single-shell tanks is, as you may know, the subject of an environmental impact statement prepared for the entire defense waste at Hanford and has been the subject of thorough review.

I met, in fact, just this week on Monday with the citizens advisory group working on that and it is their recommendation that additional studies be made and that we not attempt to do certain things with that at this time.

Obviously, we are going to review that, but it seems like some of the things these citizens are recommending are very logical and appropriate. So I would not want to rush into doing something, either, when what they are really saying is, you know, they want us to do some things now and others they are saying really should await further analysis.

So, yes, we will meet with you and, yes, we will respond to you. We want to make sure we have USGS' latest analysis, however, on that point.

Senator Adams. All right. Thank you all very much. The Chairman asked me to give his appreciation to all of you for appearing as witnesses, and this hearing will stand at recess.

[Whereupon, at 12:54 p.m., the Committee was recessed to reconvene at the call of the Chair.]

ADDITIONAL MATERIAL SUBMITTED FOR THE RECORD

United States General Accounting Office

GAO Testimony

For Release
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Environmental, Safety, and Health Aspects of the Department of Energy's Nuclear Defense Complex

Statement of
J. Dexter Peach, Assistant Comptroller General
Resources, Community, and Economic Development
Division

Before the
Committee on Governmental Affairs
United States Senate

Mr. Chairman and members of the Committee:

We are pleased to be here today to provide an overview of the General Accounting Office's (GAO's) work on environmental, safety, and health aspects of the Department of Energy's (DOE's) nuclear defense complex. Over the past several years GAO has issued over 20 reports (see attachment I), many prepared at your request, Mr. Chairman, on various aspects of the DOE nuclear defense complex.

These reports have described a variety of unresolved safety and environmental problems at DOE's nuclear defense facilities. But, more importantly, when considered together, they underline a series of critical issues that the Congress and the Administration need to face in determining the future of the DOE nuclear weapons complex.

These issues arise because (1) many of the facilities are old and some are already operating beyond their expected life, (2) unresolved concerns exist about the operational safety of many of the facilities, and (3) the lack of attention to environmental problems created by facility operations over the years has created an undefined backlog of clean-up actions needed. The cost of remodeling or building new facilities will be in the billions, as will the cost of bringing facilities into compliance with environmental laws. What the Congress needs from DOE is an overall strategic plan which defines the universe of problems it faces in rebuilding its nuclear defense complex. This strategy should include not only actions needed to rebuild or upgrade facilities with time frames and cost estimates, but also actions needed to protect the environment and assure the Congress and the public of DOE's safe operation.

Let me briefly describe the types of problems we have identified in the safety and environmental areas, and some of the costs we have identified associated with addressing and resolving these and other problems at DOE's nuclear defense complex. I will begin with an overview of the complex.

DOE'S NUCLEAR DEFENSE COMPLEX

The basic mission, as you know, of DOE's defense complex is to produce nuclear material (e.g. plutonium and tritium) for defense purposes--primarily weapons and naval fuel. The overall complex can be described as costly, diverse, potentially dangerous, and aging. Let me explain.

DOE's funding request for such nuclear defense activities in each of the last 3 years has been over $8 billion. The complex itself represents a public investment of about $100 billion. It includes a wide variety of plants with interrelated purposes, such as nuclear reactors, specialized laboratories, uniquely designed plants for fabricating nuclear material, and nuclear waste facilities. The entire complex will likely grow in the future as new facilities, such as facilities for solidifying high-level radioactive waste, are added to the complex.

DOE's nuclear defense complex, considered in its entirety, is probably one of the more potentially dangerous industrial operations in the world. The operations routinely use and generate large quantities of a wide range of hazardous and radioactive materials. These materials must be handled, transported, and disposed of carefully by workers not only to prevent exposure to themselves but also to prevent these materials from being released into the environment. Because of lethal levels of radiation and high-level heat generation, many of the materials must be handled with special shielded equipment to prevent worker exposure.

DOE operations also involve controlling nuclear reactions and handling highly fissionable nuclear material. The unfortunate Chernobyl accident demonstrates the more dangerous aspects of controlling nuclear reactions and nuclear material. Finally, DOE operations must be protected against the more commonplace industrial dangers, such as fires or other processing accidents.

Along with the inherent dangers of running DOE's complex is the complicating factor that many key aspects of it are aging. In this regard, many of DOE's more hazardous facilities--reactors and reprocessing plants--were built about 30 years ago. Some either have passed or are reaching the end of their designed useful life. For example, the N-reactor in Washington State has passed its originally designed life. So have some high-level waste storage tanks. Many other facilities, such as some buildings at Rocky Flats, Colorado, reactors at Savannah River, South Carolina, and the Fernald plant in Ohio, have safety concerns because of their age.

MAJOR SAFETY ISSUES

GAO's work on safety matters at DOE facilities over the last several years has resulted in several reports that have identified important safety issues. These issues, in view of their importance and scope, raise serious questions about both the safety of individual facilities and DOE operations as a whole. Taken cumulatively they demonstrate the need for independent oversight of DOE operations. Such oversight would provide increased public assurance that DOE operations can be safely operated. I would now like to provide an example of a systematic DOE safety problem and some specific safety examples at a few DOE facilities.

In June 1986,[1] we reported to you on DOE safety analysis reports for eight of DOE's operating facilities. These reports are important documents that DOE uses to show that its facilities are safely designed, constructed, and operated. Our review showed that some safety reviews have not been approved by DOE, some provided little or no comparison with safety design criteria, and different assumptions were used in analyzing serious accidents. We also noted that DOE's safety review process is an internal DOE function carried out primarily by DOE field offices. Because an effective and well-accepted safety review process is the key to demonstrating that a nuclear facility can be safely operated, we made a number of recommendations to ensure that DOE has a credible safety review process.

The situation at the N-reactor is an example of a facility-specific safety issue DOE faces. During the past year, because of the reactor's similarities with Chernobyl, it has come under increasing scrutiny. In our August 1986 report on the N-reactor,[2] we pointed out that the reactor had been operating for 3 years beyond its expected life, and many systems and components were deteriorating, which could become safety problems. In addition, we stated that if the reactor were to operate beyond the year 2000, major renovations would be required. The Roddis panel--an independent group requested by DOE to review the N-reactor--also raised a number of specific safety issues including the need for remote shutdown capability and systems to prevent hydrogen buildup. Two panel members suggested shutting down the reactor while the remaining four called for an accelerated program to upgrade the reactor's safety systems. Subsequently, in January 1987, DOE temporarily shut down the reactor ahead of schedule to upgrade safety systems.

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[1] Safety Analysis Reviews for DOE's Defense Facilities Can Be Improved (GAO/RCED-86-175; June 1986).

DOE's Rocky Flats plant provides another example. At Rocky Flats, a new building (371) was to be built to lower workers' radiation exposure levels and reduce the danger to the public in the event of an earthquake and/or high winds. Because of technical and design problems, this new building never became fully operational. As a result, DOE is continuing to process plutonium in the old buildings, which the new one was to replace for safety and health reasons. This situation has raised safety concerns about Rocky Flats. DOE is currently studying the possible safety ramifications in the continued use of the Rocky Flats Plant.

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[2] Comparison of DOE's Hanford N-Reactor with the Chernobyl Reactor (GAO/RCED-86-213BR, August 1986).

In our ongoing work at DOE's production reactors at Savannah River, which is being done at your request, new safety issues have been identified. For example, DOE has recently reduced reactor operating power for safety reasons. We are also concerned that DOE is depending too heavily on visual inspections to detect cracks in reactor vessels. These visual inspections may not clearly identify the extent and magnitude of problems. These concerns and others are to be discussed in detail before this Committee later today by Mr. Keith Fultz, GAO's Associate Director for Nuclear and Electricity Issues. In my view, the discovery of potential safety concerns at Savannah River, when coupled with the uncertainties of the continued operation of the N-reactor, raise questions about the ability of DOE to meet future production requirements for our national defense.

Independent oversight

GAO believes these examples show an important need for increased safety oversight of DOE operations. GAO has had a long history of recommending both internal and external improvements in safety oversight of DOE's defense production activities. In a 1981 report,[3] we pointed out that one of the basic, underlying causes of shortcomings in DOE's safety programs was its structure within DOE. In that report, we argued for a separate office within DOE specifically set up to oversee safety matters within the department and that this office report to the Under Secretary at DOE.

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[3] Better Oversight Needed For Safety and Health Activities At DOE's Nuclear Facilities (GAO/EMD-81-108; August 1981).

Although DOE originally disagreed with our recommendation, in September 1985, it established an Office of an Assistant Secretary for Environment, Safety, and Health, that reports to the Under Secretary. We believe that DOE's action, in effect, adopted our 1981 recommendation.

Also in the 1981 report and again in a 1986 report, we highlighted the need for outside, independent reviews of safety analysis reports. DOE has been less responsive to this recommendation. In this regard, DOE believes that its own Office of Assistant Secretary for Environment, Safety, and Health provides sufficient independent review. In response to our recommendation, DOE stated

> ". . . an additional level of oversight, over and above that already existing under the guidance of the Assistant Secretary for Environmental, Safety, and Health, would not provide any additional assurances of the safe operations of DOE facilities. . ."

DOE's position on this matter is difficult to understand because DOE, on occasion, does use outside, independent reviews. For example, when faced with safety concerns about the N-reactor because of its design similarity to the Chernobyl reactor, DOE sought outside help. As stated earlier, the Roddis panel reviewed the safety of the N-reactor. More recently, DOE has requested the National Academy of Sciences to review other DOE reactors, including production reactors at Savannah River.

DOE's reluctance to allow for outside independent reviews carries with it important implications. First, there is no outside, independent scrutiny on a continuing basis. This places heavy reliance on DOE's information and views for ensuring safety, which may not be the same as an outside group's. The Roddis panel, demonstrated this difference in their reports, and its views led to accelerating the safety work at the N-reactor. Another implication is possible conflicts between production goals and safety functions. Conflicts can and do occur. The situation at the Fernald plant in Ohio demonstrates this problem. During the 1970's, DOE considered closing this plant. As a result, it did not make capital improvements, and equipment became obsolete. In the early 1980's, DOE's production goals increased, putting a strain on the plant's resources. According to DOE's own documents, Fernald management emphasized production over worker safety and health concerns. Finally, self-regulation provides only a minimum level of public assurance that these facilities can safely operate. This minimum level, I believe is becoming more unacceptable to the public and the Congress as more problems and issues surface in the DOE nuclear defense complex.

In view of the foregoing, I believe outside, independent oversight is critical if DOE wants to provide a high degree of public assurance that its operations are safe and conducted in an environmentally acceptable manner. We are aware that you are proposing legislation that would have the Nuclear Regulatory Commission's Advisory Committee on Reactor Safeguards review and evaluate DOE's nuclear facilities. These hearings you are conducting today, as well as in the next couple weeks, will provide an excellent opportunity for your committee to hear testimony on this proposal and explore with DOE officials the reasons they believe outside oversight is not necessary.

ENVIRONMENTAL ISSUES

Besides safety issues, our reports also have identified important environmental problems needing corrective action. If not corrected, these problems can have a long-lasting effect on the environment and pose a health threat to the general public.

In a September 1986 report,[4] we reported that DOE operations have contaminated groundwater at eight of the nine facilities reviewed. In many cases, the contamination included both hazardous and radioactive material and was at levels hundreds to thousands of times greater than drinking water standards. We also noted that at a few sites some contamination had migrated off-site, into rivers and into drinking water aquifers. We are concerned that the contamination can pose a health threat when it migrates into drinking water sources. Further, we found that the soil was contaminated at most of these facilities in areas not designed to become contaminated. While DOE does have some cleanup projects underway at a few facilities, at most it is studying the problem to better characterize the extent, type, and movement of the contamination.

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[4] Environmental Issues At DOE's Nuclear Defense Facilities (GAO/RCED-86-192; September 1986).

In a March 1986 report,[5] we addressed DOE's plans to dispose of transuranic waste--a special type of radioactive waste. Basically, DOE set forth a plan to put this waste into a geological repository. We found, however, that DOE planned to send only about 19 percent of its transuranic waste inventory to the repository. DOE was noncommittal regarding the permanent disposition of the remaining 81 percent. Since this waste is buried only a few feet underground, it can pose environmental and/or health problems if it is disturbed or migrates. Remedial actions may be necessary to either remove this waste or better immobilize the waste in place.

In a September 1986 report,[6] we found that four of nine facilities were not in full compliance with the Clean Water Act, and none had final permits for disposing of waste under the Resource Conservation and Recovery Act. As a result, at some facilities DOE is discharging waste into rivers and streams above state limits and is continuing to dispose of waste in a manner that adds to the groundwater contamination. In addition, we found that Hanford[7] had been slow to identify all units that should be regulated under the Resources Conservation and Recovery Act, and it has not identified all potential Comprehensive Environmental Response, Compensation, and Liability Act waste sites that may require corrective actions. As a result, Hanford does not know and cannot ensure the regulatory agencies, that it is appropriately managing or disposing of its radioactive and hazardous waste.

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[5] DOE's Transuranic Waste Disposal Plan Needs Revision (GAO/RCED-86-90; March 1986).

[6] Environmental Issues at DOE's Nuclear Defense Facilities (GAO/RCED-86-192, September 1986).

[7] Unresolved Issues Concerning Hanford Waste Management Practices (GAO/RCED-87-30; November 1986).

In these past reports, GAO has made recommendations to ensure that DOE operations are carried out in an environmentally acceptable manner. Specific recommendations have included that DOE develop an overall groundwater and soil protection strategy, and provide the Congress a comprehensive report on its plans, milestones, and cost estimates for bringing its facilities into compliance with applicable environmental laws. We have also previously recommended that DOE allow outside independent inspections of the disposal practices used for any waste it self-regulates. DOE has not yet decided on outside, independent inspections of waste disposal because of an ongoing study. We hope one result of this ongoing study will be to allow outside independent inspections of DOE disposal practices as we have previously recommended.

FUTURE COSTS

The cost of dealing with safety issues and environmental problems at DOE facilities will be substantial. In some cases the total cost is speculative because the solutions to problems have not yet come before the Congress. To provide a perspective, some cost estimates are summarized below.

Facility upgrades and modifications are needed at many DOE facilities to enhance safety. Currently, a $50 million safety upgrade program is underway at the N-reactor. Planned safety upgrades for the other production reactors at Savannah River will also cost several million dollars. Safety upgrade programs are also underway at other DOE facilities, such as Fernald in Ohio. Larger expenditures will also be needed in the future. For example, if the N-reactor is to continue operating beyond the year 2000, major renovations costing as much as $1.2 billion will be needed. A new production reactor--which DOE is considering--could also cost billions, even if DOE modifies and finishes construction of the partially completed commercial nuclear reactor owned by the Washington Public Power Supply System. Repairing Building 371 at the Rocky Flats plant could cost about $450 million dollars. If DOE decides to move the entire Rocky Flats plant operation for safety reasons, that move could cost billions of dollars.

Correcting environmental problems will also be costly. At the three facilities we reviewed (Fernald, and Mound in Ohio, and Y-12 in Tennessee) DOE plans to spend over $60 million to bring them into full compliance with the Clean Water Act. To get final permits at the nine facilities we reviewed DOE is changing its disposal operations, at a possible cost of $200 million. The eventual cost could be much higher depending on how site-specific environmental problems are resolved. For example, groundwater cleanup cost can easily amount to hundreds of millions of dollars at a single site. Overall, we believe the eventual cost to bring these DOE facilities into full compliance with environmental laws may be over a billion dollars.

OVERALL STRATEGY

As I said at the outset of my testimony, DOE needs an overall strategic plan that sets forth the projected facility requirements for continued nuclear weapons production; a comprehensive picture of the environmental, safety, and health issues facing DOE; and solutions to resolve them. The plan should provide a comprehensive picture of what DOE's nuclear defense complex will look like in the year 2000 and beyond, and provide a road map of how we get from here to there. The many issues and problems our work has identified that have to be addressed clearly support the need for such a road map. Also, such a strategy would be helpful to maintain continual budgetary oversight. In the longer term billions of dollars will likely be needed to assure that the DOE nuclear defense complex can safely operate; additionally, billions will be needed to bring DOE facilities into compliance with environmental laws.

Some of the broader issues that need to be addressed in this strategic plan are:

-- What are the facility requirements for continued operation of DOE's nuclear defense complex?

-- What is the full scope and extent of the environmental and safety issues facing DOE?

-- What actions will DOE take to ensure that its facilities are operated in a safe manner?

-- To what extent will DOE develop a groundwater and soil protection strategy and clean up contamination at its facilities?

Of course, the strategy should address the resolution of these questions, time frames, and total implementation cost.

Once the strategy is presented to the Congress, it will be useful in making effective legislative and budgetary decisions. Without such a plan, piecemeal solutions to issues and/or problems will occur, as they have in the past. A comprehensive strategy will also place the Congress in a better position to judge the acceptability of the scope and direction of the DOE nuclear defense complex. I hope in these hearings the Committee has the opportunity to explore the need for an overall strategy for the solution of these issues with DOE officials.

In closing, Mr. Chairman, the issues and problems we have identified today are very significant, and the Secretary of Energy needs to take corrective action immediately. Accordingly, we have today forwarded a copy of this testimony to him along with a recommendation that he initiate action on the overall strategy for the DOE nuclear defense program.

That concludes my testimony for today. We would be pleased to respond to any questions you or members of the Committee may have.

GAO REPORTS RELATED TO
ENVIRONMENTAL, SAFETY, & HEALTH
ASPECTS OF DOE OPERATIONS

NUCLEAR WASTE: Unresolved Issues Concerning Hanford's Waste Management Practices (GAO/RCED-87-30; Nov. 1986)

NUCLEAR ENERGY: Environmental Issues at DOE's Nuclear Defense Facilities (GAO/RCED-86-192; Sept. 1986)

NUCLEAR SAFETY: Comparison of DOE's Hanford N-Reactor With the Chernobyl Reactor (GAO/RCED-86-213BR; Aug. 1986)

NUCLEAR WASTE: Impact of Savannah River Plant's Radioactive Waste Management Practices (GAO/RCED-86-143; July 1986)

NUCLEAR ENERGY: A Compendium of Relevent GAO Products on Regulation, Health, and Safety (GAO/RCED-86-132; June 1986)

NUCLEAR SAFETY: Safety Analysis Reviews for DOE's Defense Facilities Can Be Improved (GAO/RCED-86-175; June 1986)

ENVIRONMENT, SAFETY, & HEALTH: Status of Department of Energy's Implementation of 1985 Initiatives (GAO/RCED-86-68FS; Mar. 1986)

NUCLEAR WASTE: Department of Energy's Transuranic Waste Disposal Plan Needs Revision (GAO/RCED-86-90; Mar. 1986)

ENVIRONMENT, SAFETY, & HEALTH: Environment and Workers Could Be Better Protected at Ohio Defense Plants (GAO/RCED-86-61; Dec. 1985)

ENVIRONMENT, SAFETY & HEALTH: Information on Three Ohio Defense Facilities (GAO/RCED-86-51FS; Nov. 1985)

DOE's Plutonium Facility (GAO/RCED-85-3; Sept. 1985)

Department of Energy Acting To Control Hazardous Waste At Its Savannah River Nuclear Facilities (GAO/RCED-85-23; Nov. 1984)

DOE's Safety and Health Oversight Program At Nuclear Facilities Could Be Strengthened (GAO/RCED-84-50; Nov. 1983)

Decommissioning Retired Nuclear Reactors At Hanford Reservation (GAO/RCED-83-104; Apr. 1983)

Cleaning Up Nuclear Facilities--An Aggressive and Unified Federal Program Is Needed (GAO/EMD-82-40; May 1982)

GAO's Response to DOE on EMD-81-108, "Better Oversight Needed for Safety and Health Activities at DOE's Nuclear Facilities" (EMD-82-36; Jan. 1982)

Congress Should Increase Financial Protection to the Public From Accidents at DOE Nuclear Operations (EMD-81-111; Sept. 1981)

Better Oversight Needed For Safety and Health Activities At DOE's Nuclear Facilities (EMD-81-108; Aug. 1981)

GAO's Analysis of Alleged Health and Safety Violations At The Navy's Power Training Unit At Windsor, Connecticut (EMD-81-19; Nov. 1980)

Department of Energy's Safety and Health Program For Enrichment Plant Workers Is Not Adequately Implemented (EMD-80-78; July 1980)

Decommissioning Hanford Reactor (EMD-79-20; Jan. 1979)

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Management and Safety Issues Concerning DOE's Production Reactors at Savannah River, S.C.

Statement of
Keith O. Fultz, Associate Director
Resources, Community, and Economic Development
Division

Before the
Committee on Governmental Affairs
United States Senate

Mr. Chairman and members of the Committee:

We appreciate the opportunity to discuss our ongoing work for this Committee concerning various aspects of the Department of Energy's (DOE) production reactors at the Savannah River Plant in South Carolina. Our work is not yet complete; therefore, the information we will be discussing today is subject to change. We will continue our audit work for the next couple of months and plan to issue a report to the Committee this summer. While our audit work is still underway, some of the issues we have identified to date are potentially very serious. When these issues are taken together, the overall message they convey is a need for better management of the Savannah River Plant reactor operations.

At your request, our testimony today focuses on three specific issues we are reviewing at Savannah River: first, the testing techniques currently being used to determine potential cracks in one or more of the reactor tank walls; second, a recent reduction in the operating power of the plant's reactors for safety reasons; and third, a lack of management attention in promptly addressing identified problems with reactor operations and maintenance activities.

We would like to call your attention to the effect that two of these issues could have on DOE's ability to produce weapons-grade material for national defense. The R-reactor has not operated since 1964. The C-reactor is shut down because of cracks in the reactor tank wall. The production capacity of the remaining three operating reactors, L, K, and P, has been reduced because of the recent 26 percent power reduction. In addition, the L-reactor's production capacity is further reduced because it does not operate in the summer months. This situation at Savannah River, coupled with uncertainties about the future operation of the N-reactor in Washington State, raises questions about DOE's ability to meet production requirements.

Before discussing the details of our review, I would like to provide a brief overview of the Savannah River Plant and an overall status of the production reactors.

SAVANNAH RIVER PLANT OVERVIEW

The Savannah River Plant primarily produces plutonium, tritium, and other special nuclear materials for national defense purposes. DuPont constructed the plant in the early 1950's and has operated it for DOE under a cost reimbursement, no-fee type contract. Savannah River's major facilities include five nuclear production reactors, a plant for fabricating fuel and target elements to be used in the reactors, two chemical separations plants for processing these elements, a research and development laboratory, and various support facilities.

Two of the five nuclear production reactors at Savannah River are shut down. The R-reactor has not operated since 1964 and DOE considers it in standby status. The C-reactor has not operated since July 1985. At this time DOE does not know when, or if, it ever will be restarted. After 17 years on standby, the L-reactor was restarted in October 1985. It is not operating at full production capacity because operation during the summer months would raise the temperature of the reactor's discharge pond above state environmental standards. Further, DuPont recently reduced the operating power of the three operating reactors--L, K, and P--by about 26 percent.

I would now like to discuss specific concerns that we have identified in our ongoing work.

TESTING FOR CRACKS IN THE REACTORS

Stress corrosion cracks (cracks) have been identified in the C-reactor's stainless steel tank wall. A crack in the tank wall is of particular concern because, if it goes through the wall, radioactive water would leak from the tank and release radiation into the atmosphere. In a worst case situation, a large crack could eventually split the tank in half. Because the cracks in the C-reactor tank wall could not be repaired, it has been shut down since July 1985. Unless repair techniques can be developed, it may never operate again. Although DuPont has inspected the other reactor tanks, we are concerned that it has not used "state-of-the-art" inspection methods both to identify cracks and to determine if there is a safety or operational concern that needs immediate attention or that might cause a problem in the future.

DuPont's inspection method for the reactor tanks relies heavily on visual inspections with a periscope. This method has limitations because there is no assurance that all the weld areas have been identified because an oxide buildup on the tank walls may obscure identification of the welds. Also, many of the inspection reports cite problems with certain equipment used during the inspections.

DuPont's visual inspections have found marks on the K- and L-reactor tank walls. DuPont decided that it would use a penetrating dye to test marks which met preestablished crack criteria. The marks on the K-reactor tank wall were not dye-tested because they were smaller than the established criteria. Last fall, during a maintenance shutdown of the L-reactor, marks were identified that might have been cracks. Therefore, based on the criteria, about half of the marks identified were dye-tested to determine if they actually were cracks. No cracks were found and the L-reactor was restarted in December 1986. While DuPont believes the marks are surface corrosion, it is still analyzing scrapings from the marks to determine if this is the case. Although the dye test used for the L-reactor can identify cracks better than visual inspection, it is limited because it cannot determine a crack's depth--in other words, how close it is to breaking through the wall.

The commercial nuclear industry uses methods that differ substantially from those used by DuPont at Savannah River. The commercial industry uses ultrasonics to inspect reactor vessels. While no inspection method is exact, an ultrasonic inspection program will locate the weld areas and can determine with better accuracy than a periscope a crack's length. In addition, unlike the visual or dye tests, it can determine the depth of a crack. Because it is superior to other methods, Nuclear Regulatory

Commission officials told us that ultrasonic testing has become the accepted practice for the nuclear industry.

Although ultrasonic testing is not part of its regular inspection program, DuPont has used it to characterize the length and depth of the C-reactor cracks. According to a DuPont official, those tests showed that the cracks were longer and deeper than originally thought and also identified cracks that had not been seen visually. In addition, the Los Alamos National Laboratory, which reviewed the C-reactor repair effort at DOE's request, recommended that ultrasonic testing be used to test the effectiveness of the repair because of limitations they identified in the visual and dye tests.

Finally, the visual inspection reports for the L- and K-reactors recommend ultrasonic testing of their tanks to ensure continued safe operation of the reactors. However, DuPont does not plan to begin ultrasonic testing until 1988 and then will only inspect a portion of the tank during each reactor's normally scheduled maintenance shutdown so that production will not be affected. A full inspection could take a number of years, depending on how much is done each time.

We believe that moving to ultrasonics is an important step in enhancing the level of safety for the reactors at Savannah River. The use of ultrasonics will better identify whether cracks exist. In addition, it characterizes their length and depth so that DuPont could determine when they might become a safety or operational problem. Therefore, if cracks do exist, finding and characterizing them is critical to both assessing near-term safe operation and determining the reactors' life expectancy.

REDUCTION IN OPERATING POWER TO ENSURE SAFETY

The power level at which the Savannah River reactors operate safely is based on a number of different factors; one of them is the effective operation of the emergency cooling system. That system is designed to prevent reactor fuel melting which could potentially release large quantities of radioactive elements into the atmosphere. The emergency system would be activated in the event of an accident in which the primary system to cool the reactor core is cut off either by a pipe break or pump failure.

Since 1980 the operating reactors at Savannah River have operated at or near their maximum power levels. However, in November 1986 DuPont reduced the operating power levels of the reactors by about 20 percent; they were cut an additional 6 percent in December. These reductions were made necessary by information developed by DuPont's Savannah River Laboratory during its review of the emergency cooling system power limits developed in 1979. The laboratory's work, which reviewed the power limits established in 1979, raised questions about whether the emergency cooling system was capable of preventing fuel melting during an accident when the reactor was operating at maximum power.

The laboratory's preliminary report, issued on December 1, 1986, states that the model used to calculate the power limits has a number of limitations. For example, the reactor assembly apparatus used in the experiments did not resemble the typical Savannah River reactor assembly. Therefore, the 1979 experiments may not have provided correct information on the amount of cooling water needed to prevent fuel from melting or steam building up in the event of an accident at the reactor.

The laboratory is continuing its studies and experiments to establish the emergency cooling system power limits. It believes that the recent reductions bring the operating power to a conservative level until the final limits are established, scheduled now for sometime this fall. While the laboratory is studying the limits, DuPont is assessing a number of options to compensate for the problems raised by the 1979 experiments so that higher power levels can be resumed. One idea under consideration is adding an additional emergency cooling system to increase the amounts of cooling water flowing through the reactor assemblies.

The circumstances we have just described illustrate that the reactors had operated for about 6 years at a higher power level than may have been safe for the emergency cooling system in the event of an accident.

We understand that the National Academy of Sciences has recently become aware of this situation and is reviewing it as part of their review of the Savannah River reactors. The Academy's work at Savannah River is part of an overall review of DOE's reactors that DOE requested after the Chernobyl accident.

MANAGEMENT OF REACTOR OPERATIONS AND MAINTENANCE ACTIVITIES

We have identified other concerns that could further affect the safe operation and maintenance of the Savannah River reactors. Specifically, there does not appear to be an effective management system to ensure timely clearance of action items related to reactor operations. We are also concerned about the many problems raised in DuPont and DOE reports about the maintenance program at the complex.

Backlog of action items related to reactor operations

In 1985 DuPont established the Reactor Safety Evaluation Division to provide safety oversight. We have reviewed several of this division's reports. They generally conclude that no effective management system exists to ensure timely clearance of action items related to reactor operations. For example, a June 1986 report discusses the backlog of recommended actions stemming from the reactor incident report system. That system reports anything out of the ordinary related to reactor operations, attempts to identify its cause, and makes recommendations to correct the problem.

The report points out that the backlog is large and growing. As of the end of 1985, 198 reactor incident report recommendations, some dating back to the late 1970's, were still outstanding. This represents a 13 percent increase from the prior year. Further, the number of safety-related recommendations grew from 34 to 48 during the prior year. This represents an increase of 41 percent.

The Division's report explained the backlog's significance by comparing the situation to what led to the Three Mile Island accident. The report stated that:

> "A large backlog could contain, and conceal, a combination of faults that could lead to a serious event. The best way to minimize this possibility is to reduce the backlog to eliminate contributors or to make dangerous combinations more discernible."

We are concerned that this backlog has potential safety implications.

In addition, about 25 percent of new reactor incidents that occurred in the first 6 months of 1986 were caused by open items that had not been acted on or for which the action taken was not effective. Finally, in a November 1986 letter, the Reactor Safety Advisory Committee, a group of DuPont executives and consultants who comment on various reactor safety issues, stated their concern about the backlog of reactor incident report recommendations. They believe that the backlog may indicate a trend toward a gradual deterioration of safety at the Savannah River reactors.

To determine the extent of the backlog, the Reactor Safety Evaluation Division looked at other actions that could affect reactor operations. Its December 1986 report on this subject, which built upon information developed in their June report, identified over 1,000 items requiring action. These items, some dating back as far as 1978, include recommendations that improve safety or productivity.

Some comments made in this report include the following:

- -- Priorities are not documented for these open items and in most cases do not exist.
- -- Items related to reactor safety are not identified or highlighted as such.
- -- It is not apparent from current tracking methods if items are being actively worked on, who has responsibility, and when resolution is due.
- -- It is not possible to judge the effect that the backlog will have on staff resources, costs, and amount of time needed to reduce the backlog.

DuPont has a number of initiatives underway or proposed that it believes will reduce the backlogs and provide for better management of these action items in the future. They include designing and implementing several computerized tracking systems, reducing the number of open action items by having employees work overtime for 2 months, and studying an overall management system to ensure timely actions. To the extent possible, we will evaluate these actions in our report.

Maintenance program upgrades

Over the past few years both DOE and DuPont reports and safety appraisals have raised concerns about numerous aspects of the reactor maintenance program. Some examples of comments made in these reports are as follows:

- -- The maintenance work control system does not provide management with adequate information on (1) reactor system repair work that needs to be done and the relative significance, including safety implications of that work, and (2) the status of preventive maintenance.

-- Some maintenance activities are being conducted with little or no procedural guidance.

-- Improve and expedite the formal on-the-job training program to ensure that mechanics acquire the necessary job skills and knowledge during their 4-year training period.

In addition, our work has shown that classroom training is not provided on the specific reactor systems and equipment on which the mechanics work or on the safety importance of the equipment as required for commercial reactor maintenance personnel.

It is important to understand these comments in the context of the current reactor maintenance workforce at Savannah River. The maintenance mechanics who built and then maintained the reactors have retired. As a result, 40 percent of the maintenance workforce now are trainees. Therefore, we are concerned that inexperienced personnel are maintaining the reactors without adequate training and, in some cases, without proper written procedures. In addition, management's current monitoring system does not adequately provide information to determine the timeliness of reactor maintenance, such as when reactor repairs need to be done and the status of preventive maintenance.

DuPont also has programs planned or underway to address these concerns. Two of these programs include a system to better monitor the maintenance work and a project to write or revise over 1,000 maintenance procedures. Until these procedures are prepared and a provision for appropriate supervisory review is added, the rather inexperienced maintenance personnel will have inadequate written direction to perform some maintenance activities. In addition, DuPont is upgrading its classroom training program that it plans to implement over the next 7 years, and is pilot-testing a formal on-the-job training program.

We are concerned that management inattention contributed to the operations and maintenance problems we have described. For example, a February 1981 DOE task force report reviewed the lessons DOE could learn from the Three Mile Island accident. It recommended that Savannah River improve the content and quality of the maintenance procedures and training because its experienced maintenance people would soon be eligible for retirement. Those issues are just now being addressed. If operations at Savannah River are to improve, we believe they now must become a high priority. We are concerned that this is not the case. For example, according to a DuPont official, it will take 2 or more years to write the maintenance procedures. Furthermore, we understand that the classroom training program is already behind schedule because funds are not available to complete the maintenance task analysis, which is the basis of the second phase of the training.

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That completes my prepared statement. We will be glad to respond to any questions at this time.

COMMITTEE ON GOVERNMENT AFFAIRS.

UNITED STATES SENATE.

March 12, 1987.

Presentation by Louis H. Roddis, Jr., Consulting Engineer.

My name is Louis H. Roddis, Jr. of Charleston, South Carolina. I am a self employed Consulting Engineer, and a member of the National Academy of Engineering. My biography is appended hereto.

The principal focus of my recommendations to the Secretary of Energy are that the "N" reactor should be replaced as soon as possible. In the short term it should be shut down until a number of changes are accomplished, the chief one in my estimation being the inerting of the Zone One of the confinement, as is done in over 25% of the power reactors in the US today, including the WPPS unit 2 at Richland. The summary page of my October 3, 1986 report is appended.

Besides answering any questions on my report to the Secretary I would like to discuss the following three more general items that are touched on in my report. They are in the nature of Governmental Organization matters that were not specifically asked for by the Secretary, and hence were not shown as recomendations in my report.

First the effect of Federal budget processes on safety. In a licensed reactor (including Federal, State and Municipal owned ones) the utility must spend whatever funds are required by the NRC to effect plant safety, and take their chances of recovering these expenditures sometime in the future, if ever. The DOE however has to get funds in advance from the Congress, OMB, and their own internal processes, with no special emphasis on nuclear safety. I have no specific recommendations, the Federal Budget process is sufficiently complex already without any ideas from me.

Secondly the responsibility for the safety review process is somewhat diffused in that the contractor, the field office, the program HQ office, and the HQ ESH are all involved to some extent in the safety responsibility process. While ESH does have shutdown authority it is in case of overriding need only, in other words ESH has to positively show something is unsafe, rather than the opposite. Also the position exists at the pleasure of the Secretary. Secretary Herrington should receive great credit for establishing the position at it's present level, but another Secretary could greatly change the emphasis on this function.

1.This leads to my recommendation that the position of Assistant Secretary for Environment, Safety and Health be established as a statutory required position in the Department of Energy.

Thirdly there is a need for a credible permenant outside review of the DOE activities in the nuclear safety area. Both the independent consultants group review of "N" reactor and the NAS review committee is ad hoc in nature, and while I believe them to be credible in themselves, there is no question in my mind but that a permenant overview body should be established. I do not think it appropriate for the NRC to be involved directly, but perhaps the ACRS could be utilized, either in it's present form as an NRC appointed independent body, or better yet as one appointed by the President, which has an overview function for both the NRC and DOE. Until the division of the Atomic Energy Commission the ACRS functioned in this way. I believe it can still do so at the request of the Secretary, but this has only been done on rare occasions, and there is the problem of staffing and funding for such work, since the ACRS is now appointed and supported by the NRC.

2.This leads to my second recommendation, that the Advisory Committee on Reactor Safety be utilized by the Department of Energy to perform an overview of the Departments nuclear safety reviews in the same manner it does for the NRC licensed reactors. This should include required public reports on the construction and operation of those reactors.

In conclusion I respectfully request that my entire October 3, 1986 report to the Secretary of Energy and attachments thereto be made a part of this record.

Louis H. Roddis, Jr.

Consulting Engineer.

Attachments:
Summary page from October 3, 1986 report.
Brief biography.

LOUIS H. RODDIS, JR., P. E., C. ENG.
CONSULTING ENGINEER

October 3, 1986.

CHARLESTON, SOUTH CAROLINA 29401

The Honorable John L. Herrington, Secretary
U.S. Department of Energy.
1000 Independence Avenue, S.W.,
Washington, D.C., 20585.

Dear Mr. Secretary:

As one of the six independent consultants you asked to report on the impact of the Chernobyl-4 disaster on the operations at the "N" reactor at Hanford, WA. I submit the following report.

SUMMARY:

1. The Advisory Committee on Reactor Safeguards in 1966 identified the basic hazards of the "N" reactor as follows:

> " The Committee again points out that radiological consequences in the unlikely event of a severe reactor accident at the N-Reactor during 4000 MW(t) operation would exceed the dose guidelines now used for licensed power reactors."

I believe this situation is unchanged today.

Therefore I recommend that the Department shut down the "N" reactor unless a positive judgement is made that the requirements for defense material warrants accepting public hazards exceeding those of commercial reactors.

2. If continued operation for the next several years is considered to warrant acceptance of these hazards, then a short term Action plan should be provided and executed based on the various sources of recommendations identified in the "Recommendations" section below. Briefly these include the 88 recommendations of the Departmental review teams that have just reported to you and some additional steps, especially those aimed at reducing the potential for a hydrogen explosion.

With these changes operation at the present power levels and core loadings can continue until 1990-1991 without risks increasing much over those now existing.

3. If continued production of Defense materials is required long term, replace the "N" reactor by a less unique design, with provision for accident mitigation similar to commercial reactors. This will be a challenging task, but is not a new idea. It was studied extensively in the 1982 time frame, but never executed, apparently for economy reasons.

PREPARED STATEMENT OF FORREST J. REMICK, Ph.D.

Mr. Chairman, I am pleased to be with you today to participate in your oversight hearing concerning the amendment of the Energy Reorganization Act of 1974 to require the Advisory Committee on Reactor Safeguards (ACRS) to review and evaluate the implementation of health and safety standards at Department of Energy nuclear facilities. I'm Dr. Forrest J. Remick, Associate Vice-President for Research and Professor of Nuclear Engineering at The Pennsylvania State University. I am here today as Vice Chairman of the Advisory Committee on Reactor Safeguards. I understand that you are interested in the ACRS providing general information on:

- The extent that ACRS activities are relevant to the review of DOE nuclear facilities.
- The extent that the technical expertise of the ACRS lends itself to such a responsibility.
- The resources that would be needed for the ACRS to review and evaluate DOE nuclear facilities.
- The ACRS interest in and availability to accept such added responsibility.

The Advisory Committee on Reactor Safeguards was established by Section 29 of the Atomic Energy Act of 1954, as amended, and transferred as advisors to the Nuclear Regulatory Commission pursuant to the Energy Reorganization Act of 1974, as amended. The ACRS reviews safety studies, and applications for construction permits and operating licenses for production and utilization facilities, and makes reports thereon which become a part of the public record. It advises the Commission with regard to the hazards of proposed or existing nuclear facilities and the adequacy of proposed reactor safety standards. Further, it reviews matters specifically referred to it by the Commission, including generic issues and proposed amendments or changes to facility construction permits or operating licenses. The Committee formulates its recommendations independently of NRC staff decisions and requirements. In addition, the Committee, on its own initiative, conducts reviews of specific generic matters or nuclear facility safety-related items.

Specific areas in which the Committee has advised the NRC include nuclear power and other reactor facilities, spent fuel storage and processing facilities, handling and discharge of radioactive effluents, transportation of radioactive materials, nuclear power plant security and safeguards, the regulatory process, policy and standards, and reactor safety technology and research. The specific mix of activity has varied from year to year depending on the nature of the civilian nuclear program. Examples of typical annual activities are covered in the excerpts from NRC annual reports to the Congress for the years 1985 and 1975 which are included as attachments. In addition, specific generic reports have been written by the Committee on such varied topics as the NRC Regulatory Processes and Functions (NUREG-0642, Rev. 1, dated May 1981), Report on the Integrity of Vessels for Light-Water Power Reactors (WASH-1285 dated January 1974) and a Long Range Plan for the NRC dated October 15, 1986.

As part of the Energy Reorganization Act, the Administrator of the Energy Research and Development Administration (ERDA), the predecessor to the Department of Energy, was authorized to use, with NRC's consent, the technical capabilities of ACRS to assist the administrator of ERDA in carrying out his responsibilities. A Memorandum of Understanding between DOE and NRC exists concerning criteria and procedures for DOE requests for ACRS reviews of DOE nuclear facilities and activities which are exempt from NRC licensing requirements. Since the Energy Reorganization Act was implemented in 1974, the ACRS has, in fact, participated in the review of some DOE (or ERDA) facilities and activities including for example: the Fast Flux Test Facility, the Loss of Fluid Test Facility, the Shippingport Atomic Power Station Light Water Breeder Reactor, the Clinch River Breeder Reactor and the Naval Reactors Program. Before the Energy Reorganization Act of 1974, the ACRS participated in many reviews of AEC facilities and activities including several that DOE is now responsible for. For example, the ACRS periodically reviewed the N-Reactor at Hanford and the Savannah River production reactors.

I believe that a brief explanation about the ACRS and how is operates is necessary.

The members of the ACRS are appointed by the NRC for terms of four years each to perform the statutory functions of the Committee as part time technical advisors. They are experienced and highly qualified engineers and scientists representing several of the key technical disciplines involved in the siting, design, construction, and operation of nuclear power plants. The current membership includes eight university professors of nuclear engineering, chemical engineering, environmental engineering, and structural engineering and physics; four engineers from industry; and two engineers or scientists from the National Laboratories. A list of ACRS Members and a summary of each member's background are attached for your information. In addition, the ACRS has available to it for advice the services of about 70 expert consultants. While the ACRS has offices in Washington, D.C. its members reside across the nation. The work of the ACRS is supported by a full-time staff of 20 professional engineers who provide technical support plus additional administrative support personnel.

The ACRS members themselves serve only part-time, but the average member spends about 130 days a year on ACRS activities of which approximately equal amounts are spent at meetings of the full committee or of subcommittees, and a comparable amount doing the "homework" required to prepare for those meetings.

The committee normally reviews each licensed nuclear plant twice, once at the construction permit stage, and again several years later at the operating license stage. At each stage, the review is initiated when the applicant (the utility) submits a safety-analysis report comprising multiple volumes of detailed technical information relating to the safety of the plant. Copies of these reports are sent to the ACRS, and a subcommittee of four to five members is assigned to the project. The NRC Staff, consisting of about 600 professional engineers, begins its review at this time. During the review by the NRC Staff, the ACRS is kept fully informed and receives copies of all correspondence and minutes of meetings between the NRC Staff and the applicant.

If the proposed plant is a "standard" design and the site appears to be generally acceptable, the ACRS review usually will not begin until the NRC Staff has nearly completed its detailed review of all the safety-related features of the facility. However, if the plant design involves a new or modified concept or features or if there are special problems with the site, the committee will begin its formal review earlier in the process and meetings will be held with the applicant and the NRC Staff to develop information and to make the views of the ACRS known to them in a timely fashion.

Normally, the NRC Staff and the ACRS subcommittee will have finished their review of the project before it is brought before the full ACRS at one of its regular three-day monthly meetings. At this stage, the committee has the benefit of a comprehensive Safety Evaluation Report prepared by the NRC Staff and a detailed report from its subcommittee, which has met with the Staff and the applicant at least once, and in some cases several times, and which has visited and toured the site, at the construction permit stage, and the completed or nearly completed plant, at the operating license stage. A meeting of the full committee with the applicant and the NRC Staff usually lasts at least four hours, and more than one such meeting may be required before all safety questions are resolved and the ACRS position established. Presentations are made by the Staff, the applicant, and their contractors or consultants, and questions are asked by the ACRS members. The Committee usually concentrates its efforts on those aspects of the plant design which are new, novel or questionable for some particular reason (e.g., failure to meet an NRC safety criteria), leaving the detailed and more comprehensive review of each project to the NRC technical staff. In this way the Committee can focus its technical judgment on the cutting edge of safety technology with some assurance that a complete, in-depth safety review is being conducted by the NRC Staff.

When the ACRS has completed its review, the report required by law is prepared and submitted to the NRC Commissioners via its Chairman. Almost without exception, this report addresses a number of safety-related questions and indicates the views of the ACRS as a body on what should be done to resolve them. Although, strictly speaking, these views are only advisory to the NRC, they must be considered by the Commission and its Staff. In addition, they are noted in the technical press and studied carefully by other applicants and by the architect-engineer firms and reactor vendors who are responsible for designs.

The independence and influence of the ACRS stems partly from its Congressional charter and partly from its independence and expertise. Many of the safety-related questions that have required extensive study by the NRC Staff and the nuclear industry have first been raised by the ACRS. Its views on reactor safety are recognized as being conservative and concerned primarily with the health and safety of the public. The Committee has frequently recommended features in particular nuclear plants which go beyond minimum NRC requirements which set the limit for NRC staff consideration of safety related matters.

I have provided this somewhat detailed explanation because any added responsibilities assigned to the ACRS in the review and evaluation of DOE nuclear facilities and activities will be limited by:

- available time of the members
- available expertise of the members
- available technical support

The first concern is time. Currently the ACRS Members, who are part-time, special Government employees are devoting, on the average, some 130 days per year to ACRS activities. I point this out to indicate that there are limitations as to the amount of additional review activities that the ACRS can effectively handle.

The second concern is expertise. Most of the expertise of the ACRS is in disciplines related to nuclear power plant safety and nuclear waste management. We do have available to us a number of consultants that augment our capabilities but if our role is enlarged to include activities greatly different from what we are currently doing, we might be faced with finding members and/or consultants with different expertise. It is for this reason that our review of activities such as weapons testing and enrichment plants would not fall within our purview of expertise.

The third concern is that of available technical support. We have a small internal professional staff and as previously indicated we rely on the NRC Staff to perform thorough and detailed technical analyses of the projects that we review. Reviewing an analysis is greatly different from performing the analysis. We believe we can be more effective by questioning the assumptions, the standards, the analytical procedures used and the results obtained rather than by performing the analysis. As the NRC Staff will not be involved in the review and evaluation of DOE nuclear facilities, we will need similar support from the Department of Energy. This could be a substantial DOE effort if DOE does not now have a group that similarly performs in-depth technical safety studies and analyses.

The additional resources that would be required are very dependent on both the type of our review and in the number of reviews that we do. I believe that the ACRS can, with some modest increase in its staffing level and funds, undertake a limited number of reviews of DOE facilities. Review of 2-4 DOE facilities per year appears reasonable. The additional resources required can be better determined after the number and type of reviews are better developed.

In summary, I wish to indicate that the ACRS will gladly expand the scope of its operations to include a limited number of reviews of DOE nuclear facilities and activities if it is the desire of Congression that we do so. Such reviews and evaluations should be restricted to areas of our general expertise involving nuclear reactor safety and radiological waste management; substantial technical support from DOE will be required; and, some increase in our internal staff and funding support would be required.

EXCERPTS FROM NRC ANNUAL REPORT TO THE U.S. CONGRESS
FOR THE YEAR 1985

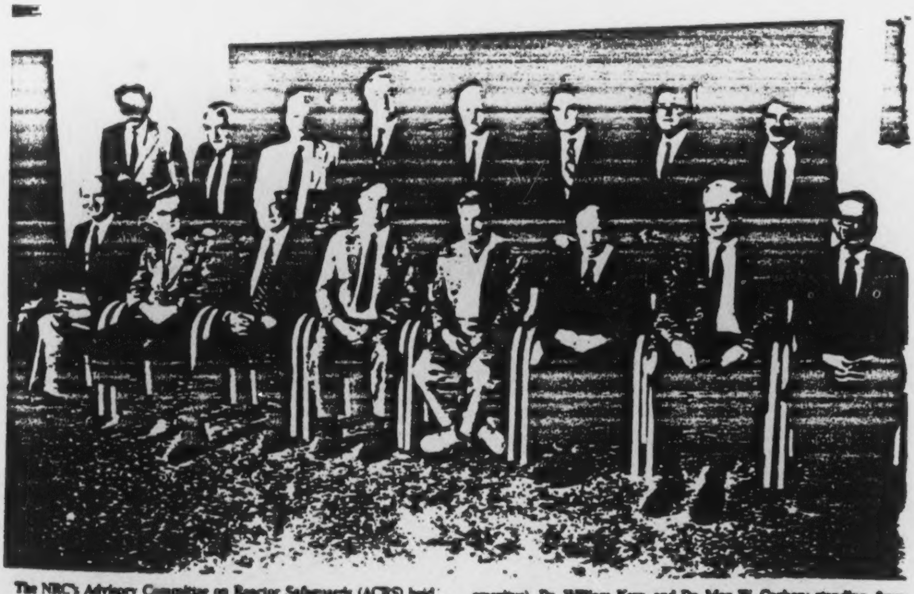
Advisory Committee on Reactor Safeguards

The Advisory Committee on Reactor Safeguards (ACRS), established by statute in 1957, provides advice to the Commission on potential hazards of proposed or existing reactor facilities and on the adequacy of proposed safety standards. The Atomic Energy Act of 1954 also requires that the ACRS advise the Commission with respect to the safety of operating reactors and perform such other duties as the Commission may request. Consistent with the Energy Reorganization Act of 1974, the Committee will review any matter related to the safety of nuclear facilities specifically requested by the Department of Energy (DOE). Also, in accordance with Public Law 95-209, the ACRS is required to prepare an annual report to the U.S. Congress on the NRC Safety Research Program.

The ACRS reviews requests for preapplication site and standard plant approvals, each application for a construction permit or an operating license for power reactors, applications for licenses to construct or operate test reactors, spent fuel reprocessing plants and waste disposal facilities.

Consistent with the statutory charter of the Committee, all ACRS reports, except for classified reports, are made part of the public record. Activities of the Committee are conducted in accordance with the Federal Advisory Committee Act which provides for public attendance at and participation in Committee meetings. The ACRS membership, which is drawn from scientific and engineering disciplines, includes individuals experienced in chemistry and chemical engineering, electrical engineering, mechanical engineering, structural engineering, reactor operations, reactor physics and environmental health.

During fiscal year 1985, the Committee completed its annual report to Congress on the NRC Safety Research Program for fiscal years 1986 and 1987, and its annual report to the Commission on the Safety Research Program and Budget for fiscal year 1987.



The NRC's Advisory Committee on Reactor Safeguards (ACRS) held its 300th meeting in April 1985, when this photo was taken. Members of the ACRS are, as seated, from left to right, Dr. Dade W. Moeller, Dr. Chester P. Siess, Mr. Jesse C. Ebersole, Mr. David A. Ward (Chairman), Dr. Harold W. Lewis (Vice Chairman), Mr. Harold Etherington (member emeritus), Dr. William Kerr, and Dr. Max W. Carbon; standing, from left to right, are Dr. Robert C. Axtmann, Dr. J. Carson Mark, Mr. Glenn A. Reed, Dr. Forrest J. Remick, Dr. Paul G. Shewmon, Mr. Charles J. Wylie, Mr. Carlyle Michelson, and Dr. David Okrent.

ATTACHMENT 1

The ACRS maintains a fellowship program enlisting graduate and post-doctoral nuclear scientists and engineers to assist in the committee's work. Shown above ACRS Senior Fellow John A. MacEvoy confers with ACRS Chairman David A. Ward, at right.

The Committee also provided special topical reports to the NRC, individual Commissioners and others on a variety of issues, including:

- Proprietary Probabilistic Risk Analysis for Future Final Design Approval on a Proposed Standard Plant.
- Questions Regarding the Proposed NRC Severe Accident Policy.
- Control Room Habitability.
- Use of the "Check-Operator" Concept for Licensed Reactor Operator Requalification.
- Need for Information Concerning Preferred Operator Action for Postulated Scenarios in which a.c. Power is Restored After Severe Core Damage has Occurred.
- Possibility of an Organization like the National Transportation Safety Board (NTSB) for Nuclear Safety.
- A "Base" Program of NRC Safety Research.
- Notification of NRC of Significant Results Arising from Industry-Sponsored Probabilistic Risk Assessments.
- Comments on NRC Programs for the Quantification of Seismic Design Margins.
- National Academy of Sciences Study of Human Factors Research Needs in Nuclear Regulatory Research.
- Consideration of Earthquakes in Off-site Emergency Planning.
- Provisions for Protection Against Sabotage.
- Incident Investigation at the Davis-Besse Nuclear Power Station.
- ACRS Comments on Primary Coolant System Defect Evaluation.
- Emergency Preparedness for Fuel Cycle and Other Radioactive Material Licensees.
- Nuclear Power Plant Control Room Habitability.
- Status Report on Long Range Planning.
- Systematic Analysis of Operating Plants for Severe Accidents.
- INPO Program on Radiation Protection.

The Committee's activities during the report period reflected the continuing licensing activity within the Commission and included six reports on requests for nuclear power plant operating licenses and one review of an operating plant evaluated as part of the systematic evaluation program.

In addition to its reports on licensed reactors and operating license applications, the Committee provided advice to NRC on proposed rules, criteria, or regulatory guides, including:

- Proposed Amendments to 10 CFR 20 to Specify Residual Radioactive Contamination Limits.
- NRC Proposed Final Rule on Pressurized Thermal Shock Events.
- Identification of New Unresolved Safety Issues.
- Backfitting Requirements.
- Regulatory Guide 1.28, Revision 3, "Quality Assurance Program Requirements (Design and Construction)."
- Proposed Rule Change to 10 CFR Part 50 Appendix E: Deletion of the Unusual Event Emergency Classification.
- Proposed Rule on Backfitting.
- NRC Staff Proposal for the Resolution of USI A-44, "Station Blackout."
- Proposed Amendments to 10 CFR 60, "Disposal of High-Level Radioactive Waste in Geologic Repositories."
- Proposed Regulatory Policy for Advanced Reactors.
- Severe Accident Policy—Systematic Review of Nuclear Power Plants.
- ACRS Action on Proposed Regulatory Guide, Task No. IC 127-5.
- ACRS Action on the Proposed Revisions to Appendix J of 10 CFR 50 and the Related Regulatory Guide.
- Proposed NRC Safety Goal Evaluation Report.
- NRC Maintenance and Surveillance Program Plan.
- Status of USI A-46 (Seismic Qualification of Equipment in Operating Plants).
- Proposed Resolution for USI A-43, "Containment Emergency Sump Performance" and Regulatory Guide 1.82, Revision 1, "Water Sources for Long Term Recirculation Cooling Following a Loss of Coolant Accident."
- ACRS Action of the Proposed Revision 2 to Regulatory Guide 1.99.

The Committee commented in three reports on the NRC Staff's proposed priority rankings for newly identified generic issues.

The Committee also prepared four reports on events of particular interest at operating reactors and three reports dealing with various aspects of the NRC's civilian radwaste program.

In accordance with the procedures embodied in NRC Manual Chapter 4125, the Committee reviewed a Differing Professional Opinion concerning the proposed final rule on pressurized thermal shock.

In performing the reviews and preparing the reports cited above, the ACRS held 12 full Committee meetings and 104 subcommittee and working group meetings. Members of the Committee also participated in several conferences and visits to exchange safety-related information with foreign groups engaged in nuclear regulatory and development activities.

The ACRS met with the Groupe Permanent Reacteur in Paris, France, on May 20-22, 1985 and with the Reaktor-Sicherheitskommission in Munich, Federal Republic of Germany, on May 23-24, 1985. During these meetings specific items concerning safety, availability and reliability of standardized and next generation plants, improved valves, containment integrity, control room design and accident procedures, primary system blowdown on PWRs, operational experience of current plants and severe accident management were discussed.

EXCERPTS FROM NRC ANNUAL REPORT TO THE U.S. CONGRESS
FOR THE YEAT 1975

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

The Advisory Committee on Reactor Safeguards is a group established by law to review and report to the Commission on safety studies and license applications for nuclear power reactors and other major nuclear facilities such as spent fuel processing plants. The committee also provides advice to the Commission on a wide range of safety-related matters such as the adequacy of proposed reactor safety standards, reactor safety research, specific technical issues of a topical nature, and the safety of operating reactors.

During the last half of fiscal year 1975, the ACRS held a total of six regular meetings, and conducted 47 meetings of ACRS subcommittees and *ad hoc* working groups. In conjunction with subcommittee meetings, 10 site/facility visits were made.

The committee provided between January 1 and November 30, 1975, reports to the Nuclear Regulatory Commission and its predecessor (the Atomic Energy Commission) concerning construction permits for 14 nuclear power plants and operating licenses for three others. Reports were also provided regarding; (a) need for attention to protection against industrial sabotage; (b) reactor safety research; (c) evaluation models for NRC criteria for the emergency core cooling systems (ECCS) for light-water-cooled nuclear power reactors; (d) a power increase for the Rancho Seco Nuclear Station; (e) siting of the Douglas Point reactor; (f) a partial construction permit review for the Diablo Canyon Nuclear Plant; (g) cracking in boiling water reactor piping; (h) status of generic items relating to light-water reactors; (i) the General Electric Standard Safety Analysis Report (GESSAR 238); (j) the Reactor Safety Study, WASH-1400 (the Rasmussen Report); (k) emergency planning; (l) a permanent dewatering system for the Perry Nuclear Plant; (m) Fast Flux Test Facility interim review; (n) Combustion Engineering Standard Safety Analysis Report (CESSAR-80); (o) Westinghouse Standard Safety Analysis Report (RESAR-41); and (p) operation of the loss of Fluid Test Facility.

The committee also provided comments and recommendations regarding its future role and scope of activities in providing advice to the Nuclear Regulatory Commission, and a proposed change in the legislative requirement that the ACRS review all construction permits and operating licenses for nuclear power plants.

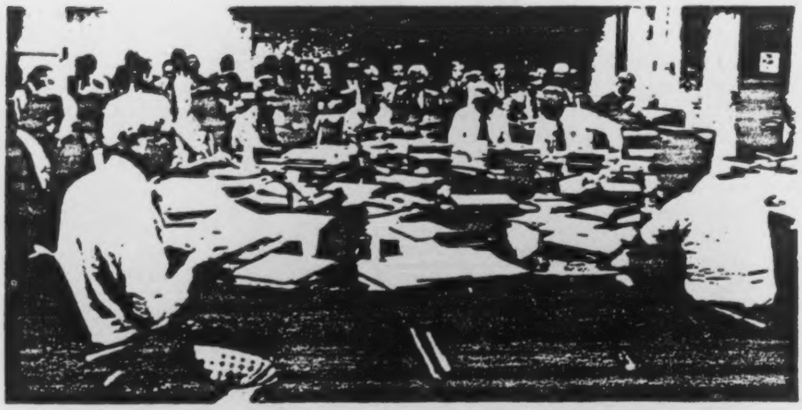
The ACRS provided advice to the Executive Director for Operations, NRC, on the following subjects:

(1) Locking out of ECCS power-operated valves;
(2) Safe-end welds on the Beaver Valley plant;
(3) Documentations of seismic design bases to be applied east of the Rockies;
(4) Anticipated transients without scram;
(5) Qualification for radiation protection personnel;
(6) Loss-of-coolant-accident best estimate calculational methods;
(7) Containment-spray additives.

The ACRS approved and/or provided comments on five regulatory guides. The committee also approved a revision to the NRC's General Design Criterion 17—"Electrical Power Systems." The ACRS also completed a study regarding the status of the Loss-of-Fluid - Test Facility Safety Research Program and other aspects of light-water reactor safety research, and the application of foreign fast-reactor safety information to U.S. fast reactors, and provided reports to the General Accounting Office.

The committee continued to make available to the public a large number of documents relating to the activities of the ACRS since it became a statutory committee in 1957, and this process was almost completed during the year. These documents include all minutes of meetings of the committee and its subcommittees, reports from consultants, and all draft documents that had been discussed with groups outside the ACRS except those precluded by law. In addition to this effort to provide the public with a more complete understanding of the nature and scope of its activities, the ACRS and its subcommittees held 45 meetings during the last half of fiscal year 1975 with sessions open to the public. Comments from the public were received and considered at several of these meetings.

The committee provided recommendations to the Commission regarding its future role as an advisory committee and is continuing to review the manner in which the ACRS may most effectively contribute to nuclear safety in light of the establishment of the Nuclear Regulatory Commission as a separate agency.



The Advisory Committee on Reactor Safeguards, a statutory body of scientists, engineers, and other experts in fields related to nuclear safety, conducts independent reviews of nuclear power plant applications and other matters referred to it by the NRC.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

ACRS 601

ACRS MEMBERSHIP - January 16, 1987

The Advisory Committee on Reactor Safeguards (ACRS) is a statutory Committee established to advise the Commission on the safety aspects of proposed and existing nuclear facilities and the adequacy of proposed reactor safety standards, and to perform such other duties as the Commission may request.

CHAIRMAN: Dr. William Kerr, Professor of Nuclear Engineering and Director of the Office of Energy Research, University of Michigan, Ann Arbor, Michigan

VICE-CHAIRMAN: Dr. Forrest J. Remick, Associate Vice-President for Research and Professor of Nuclear Engineering, The Pennsylvania State University, University Park, Pennsylvania

Dr. Max W. Carbon, Professor and Chairman of Department of Nuclear Engineering and Engineering Physics, University of Wisconsin, Madison, Wisconsin

Mr. Jesse C. Ebersole, retired Head Nuclear Engineer, Division of Engineering Design, Tennessee Valley Authority, Knoxville, Tennessee

Dr. Harold W. Lewis, Professor of Physics, Department of Physics, University of California, Santa Barbara, California

Dr. Carson Mark, retired Division Leader, Los Alamos Scientific Laboratory, Los Alamos, New Mexico

Mr. Carlyle Michelson, retired Principal Nuclear Engineer, Tennessee Valley Authority, Knoxville, Tennessee and retired Director, Office for Analysis and Evaluation of Operational Data, U. S. Nuclear Regulatory Commission, Washington, D.C.

Dr. Dade W. Moeller, Professor of Engineering in Environmental Health and Associate Dean for Continuing Education, School of Public Health, Harvard University, Boston, Massachusetts

Dr. David Okrent, Professor of Engineering and Applied Science, Department of Mechanical, Aerospace and Nuclear Engineering, School of Engineering and Applied Science, University of California, Los Angeles, California

Mr. Glenn A. Reed, retired Plant Manager, Pt. Beach Nuclear Power Plant, Wisconsin Electric Power Company, Two Rivers, Wisconsin

ATTACHMENT 3

Dr. Paul G. Shewmon, Professor, Metallurgical Engineering Department, Ohio State University, Columbus, Ohio

Dr. Chester P. Siess, Professor Emeritus of Civil Engineering, University of Illinois, Urbana, Illinois

Mr. David A. Ward, Research Manager on Special Assignment, E. I. du Pont E. I. du Pont de Nemours & Company, Savannah River Laboratory, Aiken, South Carolina

Mr. Charles J. Wylie, retired Chief Engineer, Electrical Division, Duke Power Company, Charlotte, North Carolina

BIOGRAPHICAL DATA
ACRS MEMBERS
JANUARY 5, 1987

UNITED STATES
NUCLEAR REGULATORY COMMISSION
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January 5, 1987

MAX W. CARBON

Dr. Carbon has been with the University of Wisconsin since 1958 and has been Professor and Chairman of the Department of Nuclear Engineering and Engineering Physics since 1963. In that position, he has been involved in administration, teaching, and research related to a range of topics including nuclear fission, controlled thermonuclear fusion, radiation damage, and ap- plied superconductivity.

Before joining the University, Dr. Carbon was employed by Avco Manufacturing Corporation (1955-58), primarily as Chief of the Thermodynamics Section, in work involving the design and development of ICBM nose cones. He was with the General Electric Company at Richland, Washington (1949-55), primarily as Head of the Heat Transfer Group, in work related to the safety and cooling of the Hanford piles. He served in the U.S. Army Ordnance Department (1943-46) in the U.S. and Pacific Theatres, being discharged with the rank of Captain.

Dr. Carbon was appointed to the statutory Advisory Committee on Reactor Safeguards in 1975 and reappointed in 1979 and 1983. He also served as Chairman for calendar year 1979.

Dr. Carbon was born in Indiana in 1922 and received his higher education at Purdue University where he was awarded Bachelor's and Master's degrees in mechanical engineering in 1943 and 1947, respectively, and a Ph.D. degree in heat transfer and thermodynamics in 1949.

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JESSE C. EBERSOLE

Mr. Ebersole was born in Belzoni, Mississippi, on March 2, 1916. He received his early education in Winona, Mississippi. He was a resident of Columbus, Mississippi, until his graduation from Mississippi State College in 1938, where he obtained a special honors degree in electrical engineering. He is a member of the Tau Beta Pi honorary engineering fraternity.

He was employed with the Tennessee Valley Authority (TVA) in 1939 in the Electrical Design Division. He was a resident of Knoxville, Tennessee, during this employment with TVA except for a four-year interval beginning in 1942 in the U.S. Army Air Force where he subsequently became a B-29 Flight Engineer.

He reentered TVA in 1946 as a design engineer on hydro and fossil plants, until joining the nuclear staff in 1955. He is a graduate of the 1956 class of the Oak Ridge School of Reactor Technology.

He worked on assignment to the Oak Ridge National Laboratory from 1956 to 1960 and was then appointed to direct the technical operating program for the Gas-Cooled Experimental Reactor at Oak Ridge. His work involved the design of experimental loops and programs, mostly in high temperature gas-cooled systems.

Mr. Ebersole's work became oriented to design safety considerations early in his career. He has been an activist in the areas of integral systems engineering, system interactions, cascading failures, dedicated safety systems, and in functional-environmental separation, independence, challenge frequency and reliability of critical systems and related matters.

Mr. Ebersole was appointed to the Advisory Committee on Reactor Safeguards in April 1976, immediately after his early resignation-retirement from TVA. He was reappointed in 1980 and 1984 and was elected Chairman of the ACRS for calendar year 1984.

Mr. Ebersole's present residence is Oak Ridge, Tennessee.

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WILLIAM KERR

Dr. William Kerr was born in Sawyer, Kansas, on August 19, 1919. He received his Ph.D. in electrical engineering from the University of Michigan in 1954 and was awarded his B.S.. and M.S. (EE) from the University of Tennessee in 1942 and 1947, respectively.

From 1961-74 he was Chairman of the Department of Nuclear Engineering at the University of Michigan and has been Director of the Michigan Memorial-Phoenix Project since 1961. The Phoenix Project is a program to develop peaceful uses of atomic energy. Dr. Kerr joined the University of Michigan faculty in 1953, becoming Professor of Nuclear Engineering in 1958. He was Project Supervisor, AID (ICA) Nuclear Energy Project at the University from 1956 until 1965. Prior to joining the University of Michigan faculty, he was an instructor and assistant professor at the University of Tennessee.

Dr. Kerr's professional career has also included assignments as a consultant to Atomic Power Development Association, the Oak Ridge National Laboratory and the United States Department of State in areas related to the development and application of nuclear energy.

He is the author of publications on atomic energy, its application to devices such as a beta ray microscope, on nuclear engineering education, and on reactor safety.

Dr. Kerr is a Fellow of the American Nuclear Society, and of the AAAS, Senior Member of the IEEE, and a member of the American Society of Engineering Education. He received the A. H. Compton Award of the American Nuclear Society in 1964. He is a member of several honorary societies including Sigma Xi and Tau Beta Pi.

Dr. Kerr was appointed to the statutory Advisory Committee on Reactor Safeguards in 1972 and was elected Chairman of the Committee for calendar years 1975 and 1987. He was reappointed to the Committee in 1976, 1980, and 1984.

Dr. Kerr is married to the former Ruth Duncan. They have three sons, William, John and Scott. They reside in Ann Arbor, Michigan.

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HAROLD W. LEWIS

Dr. Lewis was born in New York City, New York, on October 1, 1923. He received his B.A. in physics from New York University in 1943 and his M.A. and Ph.D. in physics from the University of California at Berkeley in 1944 and 1948, respectively.

Dr. Lewis was appointed to the Advisory Committee on Reactor Safeguards in 1979. He was reappointed in 1983 and elected Vice-Chairman for calendar years 1985 and 1986.

From 1948 to 1951 he was a professor at the University of California at Berkeley. In 1951 he joined the Bell Telephone Laboratories at Murray Hill, New Jersey, and served as a physicist until 1956 when he joined the faculty of the University of Wisconsin. In 1964 Dr. Lewis became a member of the faculty of the University of California at Santa Barbara where he was appointed Chairman of the Department of Physics in 1965. He served in that capacity until 1970 when he was appointed Director of the Quantum Institute, a position he held until 1973. Currently, Dr. Lewis is Professor of Physics at the University of California at Santa Barbara.

Dr. Lewis also has served as a consultant to the California State Energy Commission, the Los Alamos Scientific Laboratory, the Office of Secretary of Defense, the President's Science Advisory Committee, NASA, the Department of Energy, and the Congressional Office of Technology Assessment. In 1977 Dr. Lewis was appointed Chairman of the Ad Hoc Risk Assessment Review Group responsible for clarifying the achievements and limitations of the Reactor Safety Study (WASH-1400), sometimes called the "Rasmussen Report," and the present state of risk assessment methodology. In 1975 he chaired the American Physical Society's study group on light-water reactor safety, and in 1979 was appointed to the President's Nuclear Safety Oversight Committee. He is currently a member of a panel of expert consultants to the Secretary of Energy to assess some implications of the Chernobyl accident.

Dr. Lewis is married to the former Mary Rosso. They have two children, Nina and Roger. The family resides in Santa Barbara, California.

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J. CARSON MARK

Carson Mark was born in Lindsay, Ontario, Canada, on July 6, 1913. He received a B.S. degree in mathematics and physics from the University of Western Ontario in 1935 and a Ph.D. degree in mathematics from the University of Toronto in 1939. He was a member of the Department of Mathematics at the University of Manitoba from 1938-43. From 1943-45 he was on the staff of the Montreal Laboratory of the National Research Council of Canada and transferred to Los Alamos in 1945 as a member of the war time British Mission.

Dr. Mark joined the staff of Los Alamos Scientific Laboratory in 1946 and served as the Division Leader of the Theoretical Division from 1947 to 1973. In 1973 he retired from the Los Alamos Scientific Laboratory.

Dr. Mark was also a member of the U.S. Delegation to the "Conference of Experts on Detection of Nuclear Explosions," Geneva, 1958, 1959; of the Foreign Weapons Evaluation Group, U.S. Air Force, 1953-present; of the Committee of Senior Reviewers (for classification of atomic information), USAEC, 1971-1983; and on various occasions, consultant to a number of U.S. Government agencies. He has worked in the fields of hydrodynamics, neutron physics, finite group theory, and transport theory. He has written a number of journal and encyclopedia articles concerning nuclear weapons, their effects, and the effect of a ban on nuclear weapon testing on weapons development.

On February 2, 1976, Dr. Mark was appointed to the statutory Advisory Committee on Reactor Safeguards for a four-year term and was reappointed in 1980 and 1984. He was elected Chairman for calendar year 1981.

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CARLYLE MICHELSON

Mr. Michelson received his B.S. and M.S. electrical engineering degrees, and a degree of electrical engineer, from the University of Kentucky. He received an M.S. in industrial management from the University of Tennessee and also attended the Oak Ridge School of Reactor Technology in 1953-54.

Mr. Michelson, who retired as Director of the Nuclear Regulatory Commission's Office for Analysis and Evaluation of Operational Data in 1983, began his professional career with the Tennessee Valley Authority in 1952. Upon completing the School of Reactor Technology, he was assigned for a ten-year period to various divisions within the Oak Ridge National Laboratory. Upon returning to TVA, he assisted in the design of the Browns Ferry Nuclear Plant in Alabama, including responsibility for establishing design criteria and standards, verifying functional adequacy and safety, and preparing licensing documents.

In 1970 he was named Principal Nuclear Engineer, organizing and supervising TVA's Nuclear System Analysis Section, with responsibility expanded to include comprehensive safety review, design integration, and preoperational test programs for all safety-related systems and features for TVA nuclear plants.

In 1980 Mr. Michelson transferred from TVA to the NRC where he organized and became Director of the new Office for Analysis and Evaluation of Operational Data. In recognition of his performance in this office, he was awarded the Presidential Rank of Meritorious Executive.

Until retirement, Mr. Michelson was the United States' representative on the advisory and technical review committees of the Nuclear Energy Agency and International Atomic Energy Agency concerned with the establishment and operation of international systems for the collection, assessment and dissemination of nuclear plant operational experience.

Mr. Michelson was appointed to the statutory Advisory Committee on Reactor Safeguards (ACRS) on February 24, 1983. For the period 1977-1979, he was a consultant to the ACRS in several areas, including nuclear plant security, systems interactions, emergency core cooling, licensee event reports and the Three Mile Island accident.

He has published more than 50 national and international reports and journal articles, including reports on potential consequences of acts of sabotage at nuclear plants. He also planned and authored safety analyses which were used to assure plant safety following a fire at the Browns Ferry Nuclear Plant in 1975.

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DADE W. MOELLER

Dr. Dade W. Moeller received his Ph.D. in nuclear engineering in 1957 from North Carolina State University. He was awarded a B.S. in civil engineering and an M.S. in environmental engineering in 1948 by the Georgia Institute of Technology.

Dr. Moeller currently serves as Professor of Engineering in Environmental Health and Associate Dean for Continuing Education for the School of Public Health, Harvard University. From 1966 through 1982 he served as Associate Director of the Kresge Center for Environmental Health at that same institution, and from 1968 through 1982 he served as Chairman of the School's Department of Environmental Health Sciences. From 1948 through 1966, Dr. Moeller served as a commissioned officer in the U.S. Public Health Service. From 1944 to 1946 he served in the U.S. Navy. His principal experience has been related to radiation protection, nuclear power plant air-cleaning systems, the disposition of radioactive wastes, and environmental radiation surveillance. His duty assignments with the U.S. Public Health Service included the Oak Ridge, Tennessee, and Los Alamos, New Mexico, installations at the Atomic Energy Commission (now the Department of Energy) and the headquarters office of the Radiological Health Program of the Public Health Service in Washington, D.C.

From 1957 to 1961 he served as Chief of Radiological Health Training Activities, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. During the period from 1961 to 1966, he served as Officer in Charge, Northeastern Radiological Health Laboratory, Public Health Service, U.S. Department of Health, Education and Welfare, Winchester, Massachusetts.

Dr. Moeller is a member of the Health Physics Society, the Air Pollution Control Association, the American Industrial Hygiene Association, and the American Association for the Advancement of Science.

He currently serves on a number of committees in the field of radiation protection and has received professional recognition through certification by the American Board of Health Physics. Dr. Moeller is also a Diplomate of the American Academy of Environmental Engineers and a Fellow of the American Public Health Association and the American Nuclear Society.

He is a member of the National Academy of Engineering, the National Council on Radiation Protection and Measurements, and a former member of Committee 4 of the International Commission on Radiological

Protection. He is past chairman of the American Board of Health Physics and the National Air Pollution Manpower Development Advisory Committee, U.S. Environmental Protection Agency; he is also past president of the Health Physics Society.

Dr. Moeller was appointed to the statutory Advisory Committee on Reactor Safeguards on January 1, 1973 and reappointed in 1977, 1981, and 1984. He served as Chairman during calendar year 1976.

Dr. Moeller is married to the former Betty Radford of Decatur, Georgia, and they have four sons and a daughter. He and his wife reside in Bedford, Massachusetts.

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DAVID OKRENT

Dr. David Okrent was born on April 19, 1922 in Passaic, New Jersey. He received a mechanical engineering degree from the Stevens Institute of Technology in 1943 and a Master's and Ph.D. degree in physics from Harvard University in 1948 and 1951, respectively. He was a Guggenheim Fellow at the University of Cambridge during 1961-62 and was again a Guggenheim Fellow in Europe and Israel in 1977-78.

Dr. Okrent is presently Professor of Engineering and Applied Science, Department of Mechanical, Aerospace, and Nuclear Engineering, School of Engineering and Applied Science, at the University of California, Los Angeles, where he has served since 1971. From 1951 to 1971 he served as a senior physicist at the Argonne National Laboratory and as a member of the Laboratory Director's staff. Prior to 1961, he was head of Argonne Laboratory's Fast Reactor Physics and Safety Section where he devoted his efforts primarily to problems associated with fast reactors and was the author of numerous publications dealing with fast reactor behavior. From 1943-1946 he was employed as a mechanical engineer for the National Advisory Committee for Aeronautics. In 1971 Dr. Okrent received the first Argonne Universities Association Distinguished Appointment Award and was a Visiting Professor of the University of Arizona. He received the first Tommy Thompson Award of the American Nuclear Society in 1980 and the Distinguished Service Award from the Nuclear Regulatory Commission in 1985.

Dr. Okrent participated in the design of the Submarine Thermal Reactor and served as Chief Physicist for the Zero Power Reactor-III and the Experimental Breeder Reactor-II at Argonne. He originated the TREAT reactor as part of the Commission's Fast Reactor Safety Program. His major publications include co-authorship of many Geneva Conference papers, a monograph on fast reactor cross sections, a book on computing methods in reactor physics, a chapter on fast reactor kinetics in the Technology of Nuclear Reactor Safety, and reports and papers on such diverse topics as the design of ZPR-III, the kinetic behavior of TREAT, and the behavior of fission gas bubbles in fuel elements during temperature transients. Dr. Okrent recently wrote a book entitled, "Nuclear Reactor Safety: On the History of the Regulatory Process."

During its existence, Dr. Okrent completed many special assignments for the U.S. Atomic Energy Commission including that of official U.S. Delegate to the First, Third and Fourth International Conferences on the Peaceful Uses of Atomic Energy, Geneva, 1955, 1964, and 1971. He served as Scientific Secretary to the Director General of the Second

Geneva Conference in 1958. He is a Fellow of the American Physical Society and the American Nuclear Society.

He served as chairman of the Mathematics and Computations Division of the American Nuclear Society (ANS) in 1964-65 and of the Nuclear Reactor Safety Division of ANS in 1972-74. He was also a member of the ANS Board of Directors. He has served on the Visiting Committee to the Department of Applied Science, Brookhaven National Laboratory and to the Reactor Safety and Analysis Division, Argonne National Laboratory. Dr. Okrent is a member of the National Academy of Engineering.

He was initially appointed to the statutory Advisory Committee on Reactor Safeguards in 1963 and was reappointed for additional four-year terms in 1967, 1971, 1975, 1979, and 1983. He served as Chairman of the Committee for calendar year 1966.

As a member of the ACRS, Dr. Okrent has served in many capacities, including Chairman of the Subcommittees on Safety Research, Extreme External Phenomena, Reliability and Risk Assessment, and Safety Criteria and Philosophy. He played a major role in the development of safety goal policy. He was the principal author of NUREG-0739, the ACRS Report entitled, "An Approach to Quantitative Safety Goals for Nuclear Power Plants."

Dr. Okrent resides in Los Angeles, California, with his wife, the former Rita G. Holtzman, and three children, Neil H., Nina D., and Jocelyne A. M.

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GLENN A. REED

Mr. Reed was born in Athens, Vermont, on March 4, 1921, graduated from Vermont Academy in 1938, and from Northeastern University (Cum Laude) BSME, in 1947. He served as a platoon sergeant in the U.S. Army Paratroops during World War II.

In 1947 Mr. Reed began a career working for electric utilities in the production of electric power. During 19 years of employment with the New England Electric System, he was on assignment to the General Electric Company, Westinghouse Electric Corporation, and the Argonne National Laboratory and worked in research and development of gas turbines and four different types of nuclear reactors. Mr. Reed worked on the first nuclear submarine reactor, the first two breeder reactors, the first series of boiling reactors, and the first organic cooled reactor experiment.

In 1956 Mr. Reed became Project Engineer for the Yankee Atomic Electric Power Plant in Rowe, Massachusetts. In 1959 he became the Rowe project Plant Superintendent, and in 1963 became Manager of Operations for the Yankee-Rowe and the Connecticut Yankee-Haddam Plants.

Mr. Reed joined the Wisconsin Electric Power Company as General Superintendent for the Point Beach Nuclear Plant in 1966 in direct charge of design, construction, and operation, and later became Plant Manager and retired from Wisconsin Electric on April 1, 1983.

He is a charter member of the American Nuclear Society and has also served as a member of the EPRI Design and Operations Committee; the EEI Nuclear Power Subcommittee; the INPO Board of Directors; and Chairman of the first EEI Ad Hoc Committee on Steam Generators. He was a licensed reactor operator and senior reactor operator and has also authored numerous technical papers on nuclear power plant operations, personnel organization and personnel selection. He also holds a patent on control of boiling water reactors.

Mr. Reed was appointed to the statutory Advisory Committee on Reactor Safeguards in January 1984.

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FORREST J. REMICK

Dr. Remick received his B.S., M.S., and Ph.D. degrees in mechanical engineering from The Pennsylvania State University. He also attended Lycoming College and the Oak Ridge (Tennessee) School of Reactor Technology.

Dr. Remick's professional career started at the Bell Telephone Research Laboratories where he was a mechanical engineer from 1955 to 1956. From 1956 to 1963 he held positions as Research Associate, Acting Director of the Nuclear Reactor Facility, and Acting Director of Curtiss-Wright Nuclear Research Laboratory at Penn State. From 1963 to 1965 he served as Associate Professor of Nuclear Engineering, Director of the Nuclear Reactor Facility, and Director of the Curtiss-Wright Nuclear Research Laboratory. In 1965 Dr. Remick was appointed Chief of the Training Section, Department of Technical Assistance, International Atomic Energy Agency in Vienna, Austria, a position he served in until 1967.

Since 1967 Dr. Remick has held a number of other positions of increasing responsibility at Penn State. These include Director of the Institute for Science and Engineering and Acting Director of the Center for Air Environmental Studies, Coordinator of University Energy Programs, Director of Intercollege Research Programs and Facilities, and Acting Vice President for Research and Graduate Studies. Currently, he holds the position of Associate Vice President for Research and Professor of Nuclear Engineering.

Dr. Remick has served on a number of committees and boards in the nuclear energy field including ten years as an Administrative Judge with the NRC's Atomic Safety and Licensing Board Panel, advisor to the National Academy of Sciences' National Research Council, member of EBR-II Review Committee, member of the Governor's Energy Council of the Commonwealth of Pennsylvania, member of the Atomic Industrial Forum's Committee on TMI-2 Recovery, member of the Institute of Nuclear Power Operations' Special Task Force on Training Alternatives, and is a member of the National Nuclear Accrediting Board. He was a consultant operator licensing examiner for the Atomic Energy Commission and the NRC for 14 years, and served from August 1981 until July 31, 1982 as Director of the NRC Office of Policy Evaluation where he reported to the five NRC Commissioners on the evaluation of technical and other policy issues.

His membership in professional societies include the American Society of Mechanical Engineers and the American Society for Engineering

Education. He is a Fellow of the American Nuclear Society. He is also a member of the National Council of University Research Administrators and a member of the Conference Committee of the National Conference for the Advancement of Research.

Dr. Remick was appointed to the statutory Advisory Committee on Reactor Safeguards in September 1982. He was reappointed in September 1986 and elected Vice-Chairman for calendar year 1987.

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PAUL G. SHEWMON

Dr. Paul Shewmon was born in Stillman Valley, Illinois, on April 18, 1930. He received his B.S. in metallurgical engineering at the University of Illinois in 1952 and his Ph.D. from Carnegie Institute of Technology in 1955.

Dr. Shewmon served as Chairman of the Metallurgical Engineering Department at Ohio State University from 1975 to 1983. From 1955 to 1958 Dr. Shewmon was a research engineer at the Westinghouse Research Laboratory. In 1958 he joined the faculty of Carnegie Institute of Technology as an assistant professor and became a full professor in 1965. He joined the staff of Argonne National Laboratory in 1967 and was Director of the Materials Science Division from 1969 to 1973. During the period from 1973 through 1975, he was Director of the Division of Materials Research of the National Science Foundation. He then became a faculty member at Ohio State University and was appointed to his present position as Chairman of the Metallurgical Engineering Department. He is the author of numerous articles and two text books in the field of metallurgy relating to diffusion in solids and transformation of metals.

Dr. Shewmon is a fellow of the American Society for Metals and the American Institute of Mining, Metallurgical, and Petroleum Engineers. He is a member of the National Academy of Sciences and the American Nuclear Society. He has received numerous awards and honors in the field of metallurgy for outstanding research. Most recently, he was awarded the University of Illinois College of Engineering Alumni Honor Award for distinguished service in engineering.

Dr. Shewmon was appointed to the statutory Advisory Committee on Reactor Safeguards in June 1977 and reappointed in 1981 and 1985. He served as Chairman for calendar year 1982.

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CHESTER P. SIESS

Dr. Chester P. Siess was born in Alexandria, Louisiana, on July 28, 1916. He received a Bachelor of Science degree from Louisiana State University in 1936 and M.S. and Ph.D. degrees in civil engineering from the University of Illinois in 1939 and 1948.

Dr. Siess is Professor Emeritus of Civil Engineering at the University of Illinois in Urbana-Champaign. As a member of the faculty since 1941, he has taught graduate and undergraduate courses and has conducted research relating to the strength and behavior of reinforced concrete members and structures. He is the author or co-author of about 80 publications on these subjects.

He has been chairman or member of numerous committees of the American Concrete Institute, the American Society of Civil Engineers, and other societies, and has been active in the preparation of structural design recommendations and codes for reinforced and prestressed concrete structures.

Dr. Siess is a member of the National Academy of Engineering and an Honorary Member of the American Society of Civil Engineers and the American Concrete Institute. He is a registered structural engineer in the State of Illinois.

Dr. Siess has been a member of the statutory Advisory Committee on Reactor Safeguards since 1968. He served as Chairman of the Committee for calendar year 1972.

Dr. Siess resides with his wife, the former Helen Kranson, in Champaign, Illinois.

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DAVID A. WARD

Mr. David A. Ward was born on November 13, 1930, in Joliet, Illinois. He received his B.S. in mechanical engineering from the University of Illinois in 1953.

In that same year, Mr. Ward began his career with E. I. du Pont de Nemours and Company as Research Engineer, Reactor Engineering Division, Savannah River Laboratory. He was promoted to positions of increasing responsibility with Du Pont over the next 22 years, and in 1975 was appointed Superintendent, Department of Reactor Technology, at Savannah River. He held that position until 1978 when he was promoted to Superintendent, Department of Reactor and Reactor Materials Technology. In May of 1980, Mr. Ward was appointed Research Manager of Nuclear Engineering. He is currently Research Manager on special assignment at the Savannah River Laboratory, a position he was appointed to in January 1985.

Mr. Ward was appointed to the statutory Advisory Committee on Reactor Safeguards in November 1980 and reappointed in 1984. He was elected Chairman for calendar years 1985 and 1986. He is also a member of the American Nuclear Society.

Mr. Ward is married and the father of nine children. Presently, Mr. Ward and his family reside in North Augusta, South Carolina.

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CHARLES J. WYLIE

Mr. Wylie was born in Morganton, North Carolina, on June 20, 1926. He graduated from the University of South Carolina in 1950 with a Bachelor of Science degree in electrical engineering. He began his professional career with Duke Power Company in 1950 and retired as Chief Engineer of the Electrical Division, Design Engineering in September 1984.

His involvement with nuclear power began in 1956 when he participated in the engineering and design of the first nuclear power electric generating station in the Southeastern United States, the pressurized heavy water tube reactor plant (CVTR-PWR) at Parr Shoals, South Carolina. From 1965 until he retired in 1984, he had total electrical engineering and design responsibility for all of Duke Power Company's new generating facilities which includes the Oconee, McGuire, Catawba and Cherokee nuclear stations, the coal-fired Marshall and Belews Creek Stations, and the Keowee, Jocassee, and Bad Creek hydro stations.

Mr. Wylie was the United States' representative to the working group which prepared the International Atomic Energy Agency "Safety Guide on Safety-Related Electrical Power Systems for Nuclear Power Plants SG-D7" and related "Assessment Guide."

Mr. Wylie is a Fellow of the Institute of Electrical and Electronics Engineers (IEEE) having long involvement in nuclear standards activities, chairing numerous committees, and is a present member of the Standards Board. He recently received the IEEE Centennial Medal for Extraordinary Achievement in Electrical Engineering. He is a member of the American Nuclear Society and has also been a committee member of the Edison Electric Institute's and the Electric Power Research Institute's Electrical Systems and Equipment Committees and past chairman of the American Society of Mechanical Engineers' Working Group on Reactor Coolant Pump Motor Frames.

He was appointed to the statutory Advisory Committee on Reactor Safeguards on September 5, 1984.

Mr. Wylie resides with his wife, Margaret Jo, in Charlotte, North Carolina.

PREPARED STATEMENT OF MARY L. WALKER

Mr. Chairman, thank you for the opportunity to testify before this Committee on the Department of Energy's reactor safety program. This morning I will present a status report on the safety of DOE's nuclear reactors and my current views on ways to provide direction for continued improvement.

Over the past year, concerns raised by the Chernobyl accident have focused considerable public attention on the safety of all reactors in this country, including those of DOE. Even before that accident, however, Secretary Herrington had begun a multi-disciplinary safety examination of all of our high and moderate hazard nuclear facilities. This was his "Technical Safety Appraisal" initiative. Then, after the Soviet incident, he called for more intensive reviews by my organization of the specific issues raised by Chernobyl. He also requested a review of N Reactor safety by six individual expert consultants, one of whom, Mr. Roddis, is represented here today. Further, he requested a review of nuclear safety at the Department's major Class A reactors by the National Academies of Science and Engineering.

Safety issues have been identified as a result of the Department's Technical Safety Appraisal program announced in 1985. This review of the operational safety of our facilities has generated a substantial number of recommendations for improvements. Our reviews have been thorough and, pursuant to the Secretary's objective, we have asked that the review teams focus not just on compliance, but safety excellence. The Department's commitment to surface publicly our detailed safety assessments, to use recognized independent experts on our teams, and to provide detailed plans concerning the implementation of the recommendations responsive to the safety findings reflect our intent that safety at DOE be an open process. As a result, of course, controversy has been growing. Some suggest nuclear safety oversight in DOE is somehow flawed; that adequate safety assurance is not being afforded at our reactors and other facilities. Our reviews have identified problems and areas where we can and should do better. That was precisely the Secretary's intent, and I hope to discuss with you the significance of these findings and the safety system that is in place to assure their resolution.

DOE Safety Analysis and Review System

An important function of the DOE nuclear safety program is the DOE Safety Analysis and Review System. This system is defined and required by the DOE Orders. There are three critical elements which make up this system. They are: 1) the Safety Analysis Report, 2) Independent Review, and 3) Operational Safety Requirements. I will define each of the elements and explain how we are actively improving the process.

First, the Safety Analysis Report (SARS) provides a comprehensive and quantitative evaluation of the potential hazards associated with a nuclear activity. This provides what is called the technical data base for which safety judgments and decisions can be shown. This is also the element on which GAO primarily focused when they did their review of the safety analysis and review systems in 1976, and more recently in 1985.

In this area, we are actively providing additional guidance for the preparations of all SARs. This guidance includes (1) "Guide to Radiological Assistant Considerations for the Siting and Designs of DOE Nonreactor Nuclear Facilities", dated January 1986, and (2) the recently updated "Nonreactors Nuclear Facilities Standards and Criteria Guide", dated September 1986. We are in the process of updating the Nuclear Air Cleaning Handbook which addresses the design and operations of ventilation and air cleaning systems important in the nuclear field. We are also developing guidance in the area of Probabilistic Risk Assessment Methodology and developing more detailed guidance for analyzing natural phenomenon hazards. These should be completed in 1987. Also, additional guidance is being developed in the area of preparing the SAR itself. This is to enhance the approach and provide consistency in analysis techniques DOE-wide. We are actively incorporating essential aspects of the above guidance and incorporating them in the DOE Orders.

The second important element in the Safety Analysis and Review System is the independent review. The DOE Orders require that a review of the project and related safety documentation be prepared by a group of experts who are independent of the project and that this review be documented. This takes the form of evaluations of the base data provided in the SAR and subsequent recommendations to either start construction or start operation of proposed nuclear operations. We are actively developing guidance in this area to assure that those reviews which are essential in the decision making process are adequately performed and properly documented.

The final element is the Operational Safety Requirements (OSR's), or for reactors, the Technical Specifications. These provide safety bounds for the operation through operational controls and limits such that the nuclear activity is conducted within the safety envelope defined by the SAR and verified by the independent review. This relationship is important. OSR's must be based on the technical analysis and related evaluations to ensure that plant operating conditions remain within safe operating conditions. We are developing guidance on the development of OSR's and to make sure that the SAR is a material part of the OSR development.

The basic safety analysis and review process described for DOE is also used at the Nuclear Regulatory Commission (NRC), in terms of the same three elements of analysis, review and operational limitations. To assure that this process is working properly, my office is actively reviewing these elements for all proposed high hazard nuclear and moderate hazard nuclear projects. In addition we plan to expand this to other DOE nuclear facilities as appropriate. Our emphasis will be on the technical adequacy of the analysis and reviews performed, and how the system, itself, has functioned.

I recognize that some have called for reviews of SAR's, by experts outside of DOE and separate from my Office's review. As part of its key responsibilities, my Office is reviewing the SAR's of high hazard nuclear facilities. In these reviews, we already make use of outside technical experts who have specialized knowledge of the operations and technologies being reviewed. One more layer of oversight would not provide significant added assurance.

Safety Oversight of Reactor Operations

At DOE, safety is a line management responsibility, and as such, flows from the Secretary through the Under Secretary, to the various DOE program secretarial officials, to the field operations office managers, and to the operating contractors. Although there have been many factors that bear on the successes and shortcomings of the Department's safety oversight system, one feature of that system is repeatedly noted by our review teams. That feature is the delegation of authority, responsibility and accountability to the Manager of each Operations Office. He is the key official who provides program directions to contractors, including implementation of the environment, safety and health program. I am convinced that all of the Managers of our Operations Offices are committed to the safe operation of our facilities.

The DOE organization includes field ES&H groups, which report directly to the Managers at each Operations offices. These groups coordinate with my Office on matters concerning safety. They are responsible for independent reviews of safety documentation, such as SAR's. They also perform independent appraisals of the contractor's program to assure compliance with DOE ES&H requirements. The Operations Office, upon identification of an unsafe condition at any facility can at any time order the shut down of that facility until corrective actions are taken. This was recently the case at the Department's Purex and Plutonium Finishing plants at Hanford, Washington, where the Richland Operations Office Manager ordered them shut down until certain safety issues were addressed and necessary corrective actions taken.

My Office provides independent ES&H oversight on behalf of the Secretary to assure an acceptable level of safety. I concur in the construction and startup of all high hazard facilities based on my Office's review of pertinent safety documentation, most notably safety analyses. My Office also conducts an independent safety appraisal program of DOE field operations. This program includes technical safety appraisals of all high hazard nuclear facilities. A recently added provision in DOE Orders established my shut down authority that is independent of the line program and derives from the overall authority of the Secretary. Quite apart from this specific authority, I am fully prepared to recommend shut down of any DOE facility which presents an unacceptable risk to workers or the public.

Adequacy of Safety Policies and their Implementation

Standards in safety and environmental protection are changing constantly as new information, and new scientific or regulatory judgments are made. As one might expect, standards have accordingly grown more stringent. One result is a situation where older facilities come under greater scrutiny for needed upgrades. It also has increased the importance of the processes by which existing standards and guides are regularly reviewed and updated, or new ones developed.

DOE establishes safety requirements through the issuance of DOE Orders which are binding on the contractors operating our facilities. These safety requirements are periodically revised to reflect evolving national and international standards. As a policy objective, the Department seeks to apply codes and standards that are consistent with those of best accepted practices. These are determined by regulatory agencies, (e.g., FAA, DOT, OSHA, NRC), and national and international standard-setting organizations (such as the American National Standards Institute and American Society of Mechanical Engineers). Given the specialized nature of DOE's reactors and nuclear facilities, the application of these requirements and guides on a one-to-one basis is often not possible or reasonable. DOE requirements therefore have emphasized what safety performance must be achieved rather than prescriptive requirements as to how safety programs are to be implemented.

That is, we meet the spirit and intent where it is not feasible nor practical to meet the letter of these guides and requirements.

As noted in the Department's response to the 1981 GAO report,"Better Oversight Needed for Safety and Health Activities at DOE's Nuclear Facilities", the Nuclear Regulatory Commission, which has a prescriptive requirements system, has an arms-length relationship with its licensees and can require only actions for which there is authority under law. DOE, on the other hand, which has a performance-based system, can more effectively address the root causes of problems, even if management-related. Many of these facilities have unique functions based on specific national defense requirements. They are all government-owned, and operated in accordance with government direction. In the past, substantial funds have been spent to upgrade facilities and to build new plants. Indeed, through nuclear safety research performed by its laboratories and research facilities, DOE routinely provides NRC with data and expertise in developing its standards. In short, DOE is not just another nuclear operator but rather is a key element of the government's program to ensure the proper development and safe operation of nuclear facilities.

Comparability with NRC and the Commercial Sector

Recent safety reviews, our own included, have raised questions regarding the degree of comparability which should exist between DOE and NRC practices. These reviews have also found instances where the the Department's standards were not sufficiently defined or interpreted to assure their effective implementation by the operating contractors. This is the down-side risk to a flexible, performance based system. Recognizing the advantages to DOE's system, but in response to the need to avoid this downside, I have established a new Office of Safety Policy whose primary function is to examine DOE safety policies and requirements, and to assure their completeness and comparability. Also, my Office of Nuclear Safety has implemented a program to develop more definitive requirements and guidance for nuclear facilities to assure that accident risk is minimized.

The Process at Work

How well has our safety system worked? It has been effective, although recent facility reviews under Secretary Herrington's initiatives indicate that shortcomings have arisen over time that require attention. During the 14 months of my tenure as Assistant Secretary, my office has performed 13 Technical Safety Appraisals, 3 quality assurance appraisals, 12 reviews of new projects, and reviews of some 25 Class A and B accident investigations. Based on these reviews, I am developing a good sense of the strengths and weaknesses of the DOE system. Although one strength continues to be the Department's record in terms of its safety statistics, which in many instances exceed those of the commercial sector, these appraisals and reviews have identified key areas for improvement. For example, there is a need to more formally implement occupational training programs at some of our nuclear facilities. Health physics practices in certain operational areas, such as instrumentation, need to be upgraded to be consistent with industry practice. At several sites, substantial upgrades in fire protection are being implemented in accordance with recommendations resulting from appraisals and reviews. With a systematic appraisal tracking system in place (Computer Assisted Tracking System - another Secretarial ES&H initiative), corrective actions will be closely monitored to assure they are timely and responsive.

I have attached a brief summary of our safety reviews of several major DOE reactors to my written testimony.

Further Options for Improvement

A number of options are being considered by DOE to further augment the current, improved safety system, including additional use of independent sources of safety expertise. We believe the use of review organizations especially tailored to meet the needs of the DOE complex, such as an organization tailored after the utilities' Institute of Nuclear Power Operations for our contractors, and a group to provide external advice/oversight of DOE's safety assurance (e.g., by an organization with functions similar to the Advisory Committee on Reactor Safeguards) could serve to strengthen the existing system without compromising it. As I have testified before, we are keeping an open mind on this issue and will support initiatives that will provide better safety assurance in the end. We are still awaiting the comments and recommendations of the NAS panel and have a number of key safety policy issues under active consideration.

Conclusion

When Secretary Herrington came to the Department of Energy two years ago, he found that a much stronger environment, safety and health (ES&H) oversight activity was needed to increase our confidence in safe operation of DOE's facilities. In response, he immediately made the strengthening of this function a high priority. The initiatives that he announced in late-1985 -- the formation of my Office, the Technical Safety Appraisal program, the Environmental Survey of all DOE sites, and more systematic followup on appraisal findings -- are the foundation of a still expanding ES&H focus in the Department. The comprehensive appraisal programs were designed to establish a baseline that characterizes the environmental, safety, and health conditions of our facilities and sites, and to develop recommendations for improvement. That process has also served to surface the root causes of environment, safety and health deficiencies in our standards and orders, the ES&H oversight system, and in the Department's balancing of ES&H concerns and program concerns; we are now making fundamental changes in all of these areas in response.

My point here is that we recognize that even with the recent strides the Department has made in safety, work remains to be done. We believe our safety oversight system for nuclear facilities is basically sound, but can be improved. The individuals and organizations charged with conducting independent reviews need to assure a higher degree of independence from programmatic influences and the appraisals of contract activities need to be more penetrating and thorough. The issue of aging nuclear facilities is one that the NRC and the nuclear utilities are just now starting to face. Our safety reviews have focused on ensuring that the Department's reactors and other nuclear facilities are operated well in an acceptable manner, by knowledgeable and well trained staff. While acknowledging that DOE faces some tough questions on whether to continue to operate these facilities or replace them, I want to emphasize to this Committee that my job is to determine if they are being operated with an acceptable level of safety.

In closing, I want to emphasize that this Department has taken note of the lessons of the Challenger accident and the Chernobyl accident. While the safety record of the Department remains good, we are acutely aware of the continuing need to be vigilant and to instill a "safety first" attitude throughout the Department and its contractors. We do not want our contractors to be satisfied with minimally acceptable practices; we will be looking to them to strive for excellence. The Department is firmly committed to making safety work in DOE and is prepared to do what is necessary to achieve a more effective safety assurance program.

Given the scope and importance of the safety issues and options for resolution being weighed within the Department and in conjunction with the National

Academies of Science and Engineering, I would be pleased to provide the Committee future updates on the progress of these deliberations. I want to thank you, Mr. Chairman, and the rest of the Committee for your attention and would be pleased to answer any questions.

APPENDIX

Status Report of Selected Major DOE Reactors

Fast Flux Test Facility (FFTF)

This facility, which is used to conduct research and development in support of the liquid metal reactor program, is located on the Hanford Reservation. Constructed in 1978, its design and construction was reviewed by the Advisory Committee on Reactor Safeguards (ACRS) and conforms to NRC license requirements. A recent Technical Safety Appraisal by my Office found that operations were based on a sound safety philosophy, and compliance findings were limited to procedural items. A number of noteworthy practices were identified that we intend to circulate to other DOE operations for consideration. Along with the Department's Experimental Breeder Reactor-II (EBR-II) test reactor at Idaho National Engineering Laboratory, FFTF is now supporting research and development into the use of non-breeding liquid-metal-cooled-reactors as potential successors to the current generation of light water reactors in use commercially in this country. These nuclear facilities as well as others designed and constructed during the era of nuclear regulation have not only met license requirements, but represent safety models from which the NRC and the industry have drawn safety standards and experiences.

N Reactor

Located on DOE's Hanford reservation in Washington state, the N Reactor is a dual purpose, 4000 Mwt reactor which started operations in 1963. Its primary purpose is the production of nuclear material for the Government's defense programs. My staff, assisted by outside technical experts, conducted three safety reviews of N Reactor in light of Chernobyl (design, operations, and graphite/containment). A total of 133 recommendations for improvement (88 that were not overlapping) were made, most on the basis of accepted industry practice and pursuit of operational excellence (beyond meeting standards in DOE orders). In addition, six expert consultants provided individual reports to the Secretary endorsing the DOE recommendations and adding others dealing with safety policy issues, such as adequacy of safety analyses, comparability to licensed facilities, and independent oversight.

In addition to actions already underway in response to the safety reviews, a proposed "action plan" (or Safety Enhancement Program) was accelerated and the reactor was placed in a stand-down condition for a six month period to begin co-incident to a scheduled refueling. This was to to permit accelerated safety improvements to be made, and other programmatic actions to be taken by the Operations Office and contractor management.

I can report to you that in the third month of the stand-down, the scheduled safety improvements and analyses are on the whole, progressing satisfactory, and no findings have been made or developments taken place which would preclude the resumption of N Reactor operations in July of this year.

Savannah River production reactors

Four nuclear materials production reactors are sited at the Savannah River Plant (SRP): C, K, L, and P reactors. C reactor has been placed on standby status due to stress corrosion cracking of the reactor tank. An extensive testing program did not reveal similar cracking in any of the other reactor tanks, which are of a different design. While this condition is being further evaluated, the operating contractor is supporting a substantial, continuing materials assessment program to ensure the integrity of the reactor vessels in all of the reactors. The other three are operating at reduced power due to concerns about the emergency core cooling system (ECCS) capacity. The operating contractor is actively examining the analytical model and experimental basis for the projected core melt associated with an ECCS accident, and various options for improving capacity are under consideration.

A design review of the SRP reactors concluded that while the designs are fundamentally sound, a number of enhancements are desirable. These include further evaluation of seismic qualification, more formal application of industry codes and standards, implementation of an environmental qualification program, and additional training of operators in the management of severe accidents. The review noted the ongoing effort by the contractor to upgrade its existing safety analysis program (which assesses sources of facility risk) and revise the SAR's for the production reactors. Full use is being made of probabilistic risk assessment techniques.

A Technical Safety Appraisal and a quality assurance appraisal were also performed at the SRP reactors. The recommendations stemming from these reviews included enhancing quality assurance (QA) staffing, provision of a policy to preclude use of drugs by subcontractors, operator training, and upgrades in the fire protection program. The recommendations for QA considered the concerns that have been raised about implementation and oversight of QA at SRP. A composite implementation plan is being prepared by the contractor which addresses the recommendations of the three appraisals and will be submitted to my Office in early April for review and concurrence.

High Flux Isotope Reactor

The High Flux Isotope Reactor (HFIR) is a 100 Mwt research reactor located at

Oak Ridge National Laboratory (ORNL). The operating safety limits for HFIR were approved by the Atomic Energy Commission on August 23, 1965. The operation of the reactor has been uneventful from the safety standpoint during its 20 year projected lifetime. Operation was authorized, however, with the understanding that ORNL would institute a surveillance program to monitor and evaluate the extent of radiation-induced embrittlement of the reactor vessel. This surveillance was important to ensure that the basis for the reactor's operating limits remained technically sound throughout the life of the facility. HFIR was shut down on November 14, 1986 after we determined that the program was not performed adequately and that the technical basis supporting a key operating limit was no longer valid.

A subsequent investigation performed by the Oak Ridge Operations Office, which was documented in a report issued on February 13, 1987, identified 13 needed actions ranging from improvements to the surveillance program to better oversight by DOE. Other investigations are underway by my Office, the program office, and the Operations Office to determine the present status of HFIR and evaluate the conditions under which it would be allowed to restart.

The broader implications of this incident are also being examined to determine applicability to other DOE reactors. In the last two weeks, a panel of experts has been convened by DOE on the issue of embrittlement under other conditions at other reactors. Their preliminary finding is that this potential is of particular significance at HFIR, with the need identified for further evaluation at the High Flux Beam Reactor at Brookhaven National Laboratory. My office has also sent five appraisal teams to major DOE reactors to conduct a first-hand review of the adequacy of safety analyses and technical specifications as they relate to the issues raised by the circumstances at HFIR. Although all of the facts are not available, it is clear that HFIR will not be allowed to start up unless DOE is convinced that 1) appropriate operating limits are in place and 2) effective management controls are assured.

Department of Energy,
Washington, DC, July 31, 1987.

Hon. John Glenn,
Chairman, Committee on Governmental Affairs,
Washington, DC.

Dear Mr. Chairman: On March 12, 1987, Mary Walker, Assistant Secretary for Environment, Safety, and Health appeared before the Committee on Governmental Affairs to discuss DOE reactor safety. Ms. Walker was accompanied by Don Ofte, then Principal Deputy Assistant Secretary for Defense Programs and Del Bunch, Deputy Assistant Secretary for Safety, Health, and Quality Assurance. On March 17, 1987, Ms. Walker appeared before the Committee to discuss environmental issues at DOE facilities. Ms. Walker was accompanied by Mr. Ofte, Michael Lawrence, Manager, Richland Operations Office; Joe LaGrone, Manager, Oak Ridge Operations Office; Robert Morgan, Manager, Savannah River Operations Office; and Ray Berube, Acting Director, Office of Environmental Guidance and Compliance.

Following those hearings, you submitted written questions for our response to supplement the record. Enclosed are the answers to those questions, which also have been sent to the Committee staff.

If you have questions, please call Michael Gilmore or Tom Todd on 586-4277. They will be happy to assist you.

Sincerely,

Thomas Dodd
(for Robert G. Rabben,
Assistant General Counsel for Legislation.)

Enclosures.

Question 1. Please describe the process by which the Department formulates and promulgates its rules and orders for environmental compliance and the establishment of safety standards.

Answer. The Assistant Secretary for Environment, Safety and Health (ASEH) is responsible for the coordination within DOE and liaison with other agencies and groups in the development of ES&H related regulations, standards, and requirements. The ASEH reviews proposed statutes, regulations, standards, and requirements for their application to and potential impact on DOE activities. In addition, the ASEH conduct research and development programs to establish baseline technical data and safety goals needed to develop standards and requirements for DOE operations.

Requirements for reviewing new licensed facility safety requirements for inclusion in the DOE Orders are specified in the DOE Orders and in particular DOE 5480.5, Safety of Nuclear Facilities, and DOE 5480.6, Safety of DOE-Owned Nuclear Reactors (Paragraphs 7.c.(7) and 7.c(13) respectively). Copies of appropriate pages from these Orders are attached. Therefore, there is a mechanism or system in place which establishes the ASEH review and inclusion of new regulatory requirements in the DOE Orders. This system has been in place since 1981. The implementation of these requirements in the past, in regard to documentation of the application of licensed nuclear facility requirements to DOE operations, has been lacking and little-to-no action has been taken in this regard. In March of 1987, the ASEH requested that all DOE program offices determine the applicability of many new licensed nuclear facility requirements on DOE operations for possible inclusion into the DOE Orders. A copy of the March 20, 1987 memorandum is also attached.

After the ASEH develops proposed standards and requirements, new or revised DOE Orders are prepared through the Assistant Secretary for Management and Administration. The process requires the review of the proposed new or revised Orders by the Department as a whole, the resolution of comments, and the implementation of the final Order or revision. The process is essentially a consensus process utilizing the technical imput from the DOE field and contractor organizations much like the NRC, after drafting policy or Rule changes, utilizes the licensed nuclear community to comment on their proposed policy. The requirements for preparation and review of new or revised DOE Orders are provided in DOE 1321.1B, Departmental Directives System, which is also attached.

(13) Ensure that program budgets provide adequate funds for health and safety requirements during all phases of facility life.

(14) Consider nuclear facility safety factors in connection with review and approval of designs, program and project proposals, and other proposals requiring Headquarters action.

(15) Obtain special technical assistance as needed in the performance of assigned functions when the expertise is not available in the office in need of assistance.

(16) Participate in selected field organization functional appraisals in accordance with DOE 5482.1B.

(17) Review and approve the field organization designation of nuclear facilities with the concurrence of EH-1.

(18) Assume the responsibilities assigned to Heads of Field Organizations in subparagraph 7e, below, for DOE program activities not assigned to a field organization.

(19) Actively monitor the decision-making process of the field organizations in determining candidate modifications/operations which can involve an unreviewed safety question.

(20) Transmit to cognizant field organizations proposed additional safety requirements beyond those required by this Order. Upon consideration of field organization assessments of such requirements and EH-1 comments, provide final approval.

(21) Transmit to EH-1 appropriate nuclear facility safety program and project direction documentation for concurrence (see paragraph 7c(13)).

c. Assistant Secretary for Environment, Safety, and Health (EH-1) performs the following functions:

(1) Provides the Secretary (S-1) with an independent safety overview and assessment of the operation of DOE-owned nuclear facilities.

(2) Establishes priorities for conducting appraisals of programs in conjunction with the Program Senior Officials and Heads of Field Organizations.

(3) Assures that nuclear facilities projects are consistent with DOE nuclear safety policy.

(4) Overviews and appraises nuclear safety activities of the cognizant Program Senior Officials and the field organizations to assure that DOE nuclear projects are accomplished in

consonance with a need for protecting the safety and health of DOE and DOE contractor employees and the public. Specific emphasis will be placed on training programs to assure that they include requirements necessary to achieve the goal of well-trained operators.

(5) Develops and maintains Department-wide qualification and training standards for operators.

(6) Assures that responsible EH personnel are proficient in the operations personnel training area, including diverse expertise so that important areas related to nuclear safety are covered.

(7) Collects new safety requirements applicable to licensed nuclear facilities and consults with the cognizant PSO to make a preliminary evaluation to determine potential applicability to DOE nuclear facilities and:

(a) Evaluates field organization assessments and PSO disposition of newly proposed requirements and considers the requirements for inclusion in DOE Orders, as appropriate.

(b) Maintains a summary of the consideration and disposition given by DOE to each of the newly proposed requirements for nuclear facilities.

NOTE: The above process for implementing newly proposed requirements into DOE Orders does not relieve the line program organization from its responsibility to assure that new requirements are considered and applied as necessary to their facilities.

(8) Reviews and concurs in the safety-related aspects of approvals granted under subparagraphs 7b(3) and 7b(4), above.

(9) Actively monitors the decision-making process of the field organizations in determining candidate modifications/operations which can involve an unreviewed safety question.

(10) Develops guidance and establishes requirements for nuclear facility safety policy.

(11) Conducts technical safety appraisals of DOE high hazard and selected other nuclear facilities. Planning and conduct of these appraisals will be coordinated with appropriate field organizatons and Headquarters program offices to minimize overlap or duplication of effort. Appropriate field organization and Headquarters program offices will be requested to participate.

(12) Participates in selected field organization functional appraisals in accordance with DOE 5482.1B.

(14) Consider reactor safety factors in connection with review and approval of designs, program and project proposals, and other proposals requiring Headquarters action.

(15) Obtain special technical assistance as needed in the performance of assigned functions when the expertise is not available in the office in need of assistance.

(16) Participate in selected field organization functional appraisals in accordance with DOE 5482.1B.

(17) Assume the responsibilities assigned to Heads of Field Organizations, in paragraph 7e, below, for DOE program activities not assigned to a field organization.

(18) Actively monitor the decisionmaking process of the field organizations in determining candidate modifications/operations which can involve an unreviewed safety question.

(19) Transmit to cognizant field organizations proposed additional safety requirements which are above those required by this Order. Upon consideration of field organization assessments of such requirements and EH-1 comments, provide final approval.

(20) Transmit to EH-1 appropriate reactor safety program and project direction documentation for concurrence (see paragraph 7c(5)).

c. Assistant Secretary for Environment, Safety, and Health (EH-1) performs the following:

(1) Provides the Secretary (S-1) with an independent safety overview and assessment of the operation of DOE-owned reactors.

(2) Establishes priorities for conducting appraisals of reactor programs in conjunction with the Program Senior Officials and Heads of Field Organizations.

(3) Develops guidance and establishes requirements for nuclear reactor safety policy.

(4) Assures that reactor projects are consistent with DOE reactor safety policy.

(5) Reviews and concurs in nuclear reactor safety program and project direction issued by the PSO to the field that affects more than one field organization.

(6) Overviews and appraises reactor safety activities of the cognizant PSO and the field organization to assure that DOE reactor projects are accomplished in consonance with a need for protecting the safety and health of DOE and DOE contractor employees, and the public. Specific emphasis will be placed on training programs to assure that they include the requirements necessary to achieve the goal of well trained operators.

(7) Reviews and concurs in the safety-related aspects of approvals granted under paragraph 7b(3), above.

(8) Participates on selected field organization functional appraisals in accordance with DOE 5482.1B.

(9) Conducts technical safety appraisals of DOE Category A reactors and selected Category B reactors. These appraisals will be coordinated with appropriate field organization and Headquarters program offices to minimize duplication of reviews. Appropriate field organization and Headquarters program offices will be requested to participate.

(10) Develops training fundamentals covering fields such as nuclear theory, heat transfer, fluid flow, and thermodynamics for DOE application.

(11) Issues and keeps current Attachment 1, which identifies the officials having program safety responsibility for each DOE-owned reactor.

(12) Assures that responsible EH personnel are proficient in the operations personnel training area, including diverse expertise so that important areas related to nuclear safety are covered.

(13) Collects new safety requirements applicable to licensed nuclear reactors and consults with the cognizant PSO to make a preliminary evaluation to determine their potential applicability to specific DOE-owned reactors, and:

(a) Evaluates field organization assessments and PSO disposition of newly proposed requirements and considers the requirements for inclusion in DOE Orders as appropriate.

(b) Maintains a summary of the consideration and disposition given by DOE to each of the newly proposed requirements for DOE-owned reactors.

NOTE: The above process for implementing newly proposed requirements into DOE ES&H Orders does not relieve the line program organization from its responsibility to assure that new requirements are considered and applied as necessary to their facilities.

MAR 2 0 1987

EH-1

Nuclear Regulatory Commission Safety-Related Rulemaking Actions

S. Foley, DP-1
D. Rossin, NE-1
A. Trivelpiece, ER-1

This agency has long supported the policy objective of comparability between the safety requirements imposed on DOE facilities and those applied to comparable licensed facilities (See Attachment 1). DOE 5480.5 (Safety of Nuclear Facilities) and DOE 5480.6 (Safety of Department of Energy-Owned Reactors) calls for the identification of new safety requirements and consultation with cognizant Program Secretarial Officials concerning their potential applicability to DOE nuclear activities. These requirements, codified in 1981, also reaffirm the line management responsibility for the routine assessment and disposition of newly issued NRC safety requirements.

In keeping with this provision, my Office has reviewed recently issued NRC rules pertaining to licensed nuclear facilities and reactors. The attached list (Attachment 2) represents the results of that review and identifies recently issued NRC rules (completed since 1981) which may have applicability to DOE activities.

In developing the attached list, preliminary judgments were made by my staff on the applicability of the rules to DOE activities given the large number of rule issuances and modifications during this time period. Accordingly, this does not represent an exhaustive list of the total rules issued.

Please review the attached NRC rules with your cognizant field and contractor personnel for possible application to your programs and facilities. To aid my Office in making a final determination of applicability, your response should include:

(a) A determination of applicability to your programs and facilities. Reference to prior documentation developed by your organization is sufficient. If your organization has not previously reviewed a rule and your determination is that it is not applicable to your program or facilities, a brief statement of your reasons for believing that it is not applicable should be provided;

(b) If new requirements found in these rules were determined to be applicable to your program or facilities, a statement of actions taken by your organization to require their implementation, and whether the rules, as written, or the intent of the rules, are being met. If the latter, provide a brief description of how the intent of the rules are being implemented in your program or facilities;

(c) If applicable, and not being implemented, a determination as to what steps you plan to take to implement the requirements detailed in the rules; and

(d) As appropriate, your recommendations as to the need to revise the DOE ES&H Orders to incorporate the rule requirements either as stated or modified

The detail, as noted above, is necessary in order to properly document the consideration and disposition given by the Department to newly proposed safety requirements. Your response would be appreciated by May 15, 1987.

It is recognized that the NRC rulemaking language and applications do not match one-to-one with the DOE's terminology and operations. As a Department, however, we have made a commitment to site, design, construct, and operate our facilities in accordance with standards, guides, and codes which are consistent with those applied to comparable licensed facilities. Your cooperation and forebearance in performing this evaluation on this basis would be appreciated.

Obviously, other pertinent licensed facility requirements have been issued as policy statements, guides, or in other forms. These will be addressed at a later time. Likewise, it is our intent to regularly request your comments on the applicability of proposed requirements, as well. We will be considering various means by which this review process at both headquarters and the field can be performed in an effective manner. Any comments you might have on any means to help this process flow smoothly would also be welcomed.

Questions or comments regarding this request from your office or field organizations can be directed to Mr. Joseph Fitzgerald, Acting Director, Office of Safety Policy (FTS 233-5392) or Mr. Fred Volpe, of his staff (at FTS 233-5633), who will be coordinating this effort.

EH-30
D. Bunch
3/ /87
EH-20
Smithwic
3/ /87
EH-10
Bchßchee
3/ /87

Mary L. Walker
Assistant Secretary
Environment, Safety and Health

Attachment

cc: Operations Office Managers

JFitzgerald, EH-35:njp:3-5392; 3/16/87

Distribution:
OSP RF
EH-30
Subj.

ATTACHMENT 1

REGARDING COMPARABILITY

DOE Orders:

DOE 5480.5: [Purpose] To assure that: "Nuclear facilities are sited, designed, constructed, and decommissioned in accordance with generally uniform standards, guides, and codes which are consistent with those applied to comparable licensed nuclear facilities." (para. 1.a.).

DOE 5480.6: [Purpose] To assure that: "Reactors are sited, designed, constructed, modified, operated, maintained, and decommissioned in a manner that gives adequate protection for health and safety and will be in accordance with uniform standards, guides, and codes which are consistent with those applied to comparable licensed reactors." (para. 1.b).

(Same purpose or responsibilities cited in previous versions of reactor and non-reactor nuclear facility Orders, respectively: DOE 5480.1A, Chapters VI and V, 1981; as well as ERDA Manual Chapters 0531 and 0540, 1976).

DOE positions presented to Congress:

"DOE establishes safety requirements through the issuance of regulations contained in DOE Orders. These safety requirements are based on the same national and international standards and guidance NRC uses...DOE, through regular meetings with the NRC, and through reviews of newly issued regulations, continuously upgrades its regulations so that our facilities are designed, constructed, and operated consistent with comparable NRC licensed facilities."

[Response to Representative Moorhead's request: "Please describe how DOE establishes safety requirements for its reactors. On what standards are DOE's safety requirements based?" Post Hearing Questions, May 7, 1986, Hearing on Reactor Safety before the Subcommittee on Energy Conservation and Power of the Committee on Energy and Commerce, House of Representatives. Witnesses: Mary L. Walker, Assistant Secretary for Environment, Safety and Health; and Sylvester R. Foley, Assistant Secretary for Defense Programs.]

"DOE standards are fully comparable to those used by the NRC. The basic Order that established the Department's Environment, Safety, and Health Program states that DOE's nuclear facilities will be sited, designed, constructed, modified, operated, maintained, and decommissioned in accordance with the standards, guides, and codes that are applied to comparable licensed facilities."

[Response to Senator Domenici's question: "How strict are DOE's nuclear safety standards in comparison to NRC's regulations?" Post Hearing Questions and Answers Relating to the June 23, 1986 Hearing before the Subcommittee on Energy Research and Development, Committee on Energy and Natural Resources, U.S. Senate; Witness: Mary L. Walker, Assistant Secretary for Environment, Safety and Health.]

"As a policy objective, the Department seeks to apply codes and standards that are consistent with those of best accepted practices. These are determined by regulatory agencies, (e.g., FAA, DOT, OSHA, NRC), and national and international standard-setting organizations..."

[Statement of Mary L. Walker, Assistant Secretary for Environment, Safety and Health, before the Senate Committee on Governmental Affairs, March 12, 1987.]

Other Statements Regarding DOE position on Comparability:

"ERDA's policy has been and continues to be to assure that its programs are conducted in such a manner as to provide health, safety, and environmental protection equivalent to or better than that required of similar regulated activities, whether nuclear or nonnuclear."

[Correspondence of June 14, 1977 from Acting Administrator Robert W. Fri to Senator Ribicoff, Chairman, Senate Committee on Governmental Affairs; regarding GAO Report EMD-77-40, entitled "Commercial Nuclear Fuel Facilities Need Better Security."]

"...[the Deputy Secretary of Energy] stated that DOE nuclear facilities were to be safer than, or at least as safe as, those in comparable licensed facilities."

[Correspondence of May 20, 1979 from Deputy Secretary John O'Leary to Representative Jack Brooks, Chairman, House Committee on Government Operations; as referenced in "A Safety Assessment of Department of Energy Nuclear Reactors" prepared for the Under Secretary by the Nuclear Facilities Personnel Qualification and Training ("Crawford") Committee, March 1981.]

"...the Department does have a policy which we have had for some time and which we have recently reaffirmed. That is that we will have a level of requirements which are equivalent to those required by the NRC of their licensees."

[Statement of Colin Health, Acting Director, Office of Nuclear Safety, at the October 14, 1981, briefing of the ACRS Subcommittee on the DOE Response Working Group (reviewing the post-TMI review of the safety of DOE reactors).]

ATTACHMENT 2

NRC COMPLETED RULES (1981-1986, INCLUSIVE) WHICH MAY HAVE APPLICABILITY TO DOE ACTIVITIES

COMPLETED RULE	NPRM*	END COMMENT PERIOD	FINAL ACTION	EFFECTIVE
(1) Codes and Standards for Nuclear Power Plants (Summer 1981) ASME (B&PV Code) 10CFR50	2-3-82 47FR5011		7-14-82 47FR30459	
Codes and standards for Nuclear Power Plants (Winter 1981) 10CFR50	7-29-82 47FR32725	9-27-82	2-7-83 47FR05532	3-9-83 47FR05532
Codes and Standards for Nuclear Power Plants 10CFR50	4-13-82 47FR15801	6-14-82	3-15-84 49FR9711	
Codes and Standards for Nuclear Power Plants (Summer 1982) 10CFR50	12-22-82 47FR57054	2-22-83	11-4-83 48FR50878	11-4-83 48FR50878
Codes and Standards for Nuclear Power Plants (1983 Edition, Winter 1982 thru Summer 1984 Addenda) 10CFR50	5-17-85 50FR20574	7-16-85 50FR20574	9-26-85 50FR38970	10-28-85 50FR38970

The rule changes noted above reflect changes made in the ASME Boiler and Pressure Vessel (B&PV) Code as it affects 10CFR50. Obviously, new vessels used by the Department in their facilities should meet the most current version of the Code, as applicable. However, a determination should be performed to insure that the most current changes are being implemented, and if the changes to the Code are significant enough to need a re-examination of the analysis/design of existing vessels.

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* Notice of Proposed Rule-Making

NRC COMPLETED RULES (1981-1986, INCLUSIVE) WHICH MAY HAVE APPLICABILITY TO DOE ACTIVITIES

	COMPLETED RULE	NPRM*	END COMMENT PERIOD	FINAL ACTION	EFFECTIVE
(2)	Environmental Qualification of Electrical Equipment Important to Safety for Nuclear Power Plants 10CFR50	1-20-82 47FR2876	3-22-82	1-21-83 48FR02729	2-22-83 48FR02729

This rule change clarifies and strengthens the criteria for environmental qualification of electrical equipment used in nuclear power plants. It includes specific technical qualification requirements pertaining to electrical equipment important to safety whose failure could prevent the satisfactory completion of a required safety function. A determination of the application and implementation of the environmental qualification criteria on DOE facilities should be performed.

(3)	Fracture Toughness Requirements for Nuclear Power Reactors 10CFR50	11-14-80 45FR75536	1-13-81	5-27-83 48FR24008	7-26-83 48FR24008

This rule updates existing fracture toughness requirements for the reactor coolant pressure boundary for both new and existing reactor plants. A determination of the application and implementation of these requirements should be performed against existing DOE requirements for both new and existing DOE facilities.

(4)	Applicability of Technical Facility License Conditions and Specifications in an Emergency 10CFR50	8-18-82 47FR35996	10-18-82	4-1-83 48FR13966	6-1-83 48FR13966

This rule change clarifies responsibility of the licensee to take any action necessary to protect public health and safety during emergencies even though the action necessary may not be in full accord with certain provisions of the Technical Specifications. Existing DOE Orders do not specifically address this issue. A determination should be performed as to the application of such policy at DOE facilities (reactors and nuclear facilities - Operational Safety Requirements) and the need to include such a statement in the DOE Orders.

* Notice of Proposed Rule-Making

NRC COMPLETED RULES (1981-1986, INCLUSIVE) WHICH MAY HAVE APPLICABILITY TO DOE ACTIVITIES

	COMPLETED RULE	NPRM*	END COMMENT PERIOD	FINAL ACTION	EFFECTIVE
(5)	Anticipated Transients without Scram (ATWS) 10CFR50	11-24-81 46FR57521	4-23-82	6-26-84 49FR26036	6-26-84

This rule change establishes the NRC position that ATWS events should be considered and analyzed as part of the facilities safety analyses and that, if necessary, systems be designed and installed to prevent or mitigate the consequences of ATWS events. A determination should be performed as to the rules application and implementation on DOE facilities, and the need to include a similar position/requirement in the DOE Orders.

(6)	Pressurized Thermal Shock 10CFR50	2-07-84 48FR4498	5-7-84	7-23-85 50FR29938	7-23-85 50FR29938

This rule change establishes pressurized thermal shock screening criteria for axial and circumferential welds in reactor vessels based on the synergistic effects of neutron flux and thermal stress. It requires licensees to perform or re-affirm their pressurized thermal shock safety analysis which considered these effects and, if necessary, recommend flux-reduction programs for their reactors. A determination should be made as to the need for DOE to perform a similar review of its reactor facilities.

(7)	Limited Scope Modification to GDC4 Requirements for Protection Against Postulated Pipe Ruptures 10CFR50	7-1-85 50FR27006	9-2-85 50FR27006	4-11-86 51FR12502	

This rule change allows the use of "leak-before-break" technology for excluding the dynamic (pipe whip, jet impingment, etc.) effects of postulated pipe ruptures in primary coolant piping in both existing and new reactor plant designs. A determination as to the application and implementation of these new requirements on DOE facilities, both existing and new, should be performed.

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NRC COMPLETED RULES (1981-1986, INCLUSIVE) WHICH MAY HAVE APPLICABILITY TO DOE ACTIVITIES

COMPLETED RULE	NPRM*	END COMMENT PERIOD	FINAL ACTION	EFFECTIVE
(8) Interim Requirements Related to Hydrogen Control 10CFR50	12-23-81 46FR62281	2-22-82	1-25-85 50FR3498	2-25-85 50FR3498

This rule change requires improved hydrogen control systems that can handle large amounts of hydrogen during and following an accident. For the reactor designs that rely on an inert atmosphere for hydrogen control, the rule requires that certain systems and components be able to function during and following hydrogen burning. A determination as to the application and implementation of these requirements on both existing and new DOE facilities should be performed.

(9) Fitness for Duty of Personnel with Access to Nuclear Power Plants 10CFR50	8-5-82 47FR33980	10-4-82 47FR33980	8-5-86 51FR27872	9-5-86 51FR27872

This rule change establishes the need for an NRC policy statement on fitness for duty. The NRC's policy statement on fitness for duty was approved by the Commission on July 7, 1986. A determination should be performed as to the need for the Department to provide a similar policy statement on fitness for duty in the DOE ES&H Orders, and a determination made as to the present requirements implemented by DOE or its contractors in this regard.

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NRC COMPLETED RULES (1981-1986, INCLUSIVE) WHICH MAY HAVE APPLICABILITY TO DOE ACTIVITIES

COMPLETED RULE	NPRM*	END COMMENT PERIOD	FINAL ACTION	EFFECTIVE
(10)License Operator Staffing at Nuclear Power Plants 10CFR50	8-30-82 47FR38135	9-27-82	7-11-83 48FR31611	1-00-84 48FR31611
Transportation of Radioactive Material-compatibility with International Atomic Energy Agency (IAEA) Regulations 10CFR71	8-17-79 44FR48234	12-17-79	8-5-83 48FR35600	9-6-83 48FR35600
Revision of Backfitting Process for Power Reactors 10CFR50	NPRM** 9-28-83 NPRM 11-30-84 49FR47034	1-29-85 49FR47034	9-20-85 50FR38097	10-21-85 50FR38097
Radiation Surveys and In-House Inspection Systems in Radiography 10CFR34	10-4-84 49FR39168	11-18-84 49FR39168	6-16-86 51FR21737	7-16-86
General License for Shipment in Packages Approved for Use by Another Person 10CFR71	5-18-82 47FR21269		8-12-82 47FR34970	
Procedures for Picking Up, Receiving, and Opening Packages 10CFR20			12-00-83 Merged with RIN 3150-AA38 issue incorporated into revision of Part 20 proposed rule.	

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* Notice of Proposed Rule-Making

NRC COMPLETED RULES (1981-1986, INCLUSIVE) WHICH MAY HAVE APPLICABILITY TO DOE ACTIVITIES

COMPLETED RULE	NPRM*	END COMMENT PERIOD	FINAL ACTION	EFFECTIVE
(10) Cont'd.				
Source Material Transfer Reports and Tritium Inventory Reports 10CFR30; 10CFR40; 10CFR150	11-29-83 48FR53714	1-30-84	6-15-84 49FR24705	7-16-84 49FR24705
Regional Nuclear Materials Licensing for Certain Federal Facilities			4-15-85 50FR14692	4-15-85 50FR14692

In regard to the rule changes noted above, judgment as to direct or indirect applicability to DOE operations was difficult to ascertain. However, if applicability to a particular operation or site is affected by any of these rules, a determination as to the implementation and need for DOE Order changes should be performed.

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* Notice of Proposed Rule-Making

U.S. Department of Energy
Washington, D.C.

ORDER

DOE 1321.1B

4-7-83

SUBJECT: DEPARTMENTAL DIRECTIVES SYSTEM

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1. PURPOSE. To establish the permanent directives system for the Department of Energy (DOE), which shall be used for publishing directives issued by Headquarters, and addressed to Headquarters and/or field elements.

2. CANCELLATION. DOE 1321.1A, DEPARTMENTAL DIRECTIVES SYSTEM, of 6-20-80.

3. SCOPE. The provisions of this Order apply to all Departmental Elements, including the Federal Energy Regulatory Commission (RC).

4. REFERENCES.

   a. DOE 0000.1A, STANDARD SUBJECT CLASSIFICATION SYSTEM, of 8-14-79, which outlines the system to be used in identifying and numbering DOE directives, forms, and files.

   b. Federal Property Management Regulation (FPMR) 11.3, Federal Stock Number 7610-935-4176, a Records Management Handbook published by the General Services Administration, on Government-wide policy and procedures for managing a directives system.

   c. "U.S. Government Printing Office (GPO) Style Manual," outlines the form and style to be used in printed Government documents, and is used for standardization, particularly for rules of grammar and punctuation.

5. OBJECTIVES. To facilitate Departmental administration and operations by providing the right employee with the right instructions; by producing instructions that are complete, easily understood, readily accessible, and revisable; and by developing and distributing instructions promptly and economically.

6. DEFINITIONS.

   a. Directives (Orders, Notices, Announcements, and Page Changes) are written, permanent, and temporary issuances affecting more than one DOE organization, which:

      (1) Establish or change policies, organization, methods, standards, or procedures;

      (2) Guide, instruct, and inform employees in their work;

      (3) Require action or impose workload;

DISTRIBUTION:
All Departmental Elements
Federal Energy Regulatory Commission

INITIATED BY:
Office of Organization
and Management Systems

(4) Give information essential to the administration or operation of the Department; or

(5) Transmit other information to employees of the Department when use of DOE publications would not be practicable.

b. Supplemental Directives are issued by field organizations to assign local responsibilities and authorities, and prescribe procedures unique to a particular organization (see page 3, paragraph 10).

c. Internal Directives are issued by Headquarters organizations on matters applying only to the office of origin and may not be circulated outside the originating organization.

d. "Handbooks" are used to publish information of value to the public, industry, and other non-DOE entities. They are not used for matters affecting the Department when the definition in paragraph 6a is applicable.

e. Departmental Directives Control Point (DCP), Information Management Systems Branch, MA-213.1, in the Office of Organization and Management Systems, MA-21, is the Departmental control point for:

(1) The review, coordination, analysis, processing, and publication of all DOE-wide policy and procedures; and

(2) All liaison between initiating and approving officials.

f. Directives Points of Contact (DPC) are the central points of contact designated by Heads of Departmental Elements to:

(1) Represent them on all directives matters;

(2) Fulfill the responsibilities outlined in this directive, and specifically in Chapters VI and IX; and

(3) Act as liaison between their organizations and the Departmental Directives Control Point.

g. Office of Primary Interest (OPI) denotes the organization originating a directive.

7. CLASSIFIED INFORMATION. Directives are not appropriate for disseminating classified information since they are multiple-address issuances readily available to all employees. Procedures for classifying, processing, and controlling classified information will be outlined in a separate document.

8. DETERMINATION. Questions arising as to whether a document should be issued as a directive, and if so, in which format, should be referred to the Departmental Directives Control Point, Information Management Systems Branch (MA-213.1), Office of Organization and Management Systems, telephone 252-4716.

9. DESIGNATIONS. Directives applicable to the Department as a whole shall bear the prefix DOE. Those directives applicable to Headquarters organizations shall be identified by HQ. The letters "N" or "A" are added to identify a Notice or an Announcement. Chapter VII outlines the system for identifying directives.

10. APPLICATION. DOE directives are sometimes designed for general rather than detailed internal application in two or more elements of the Department. Because of variances in organization, and distribution of personnel, it is not always feasible to prepare DOE directives in sufficient detail for direct internal application in the various field elements of the Department. Therefore, DOE directives may be the bases for preparing internal supplementary directives. Supplementary directives, printed in colors different from those of the DOE system, shall not repeat material covered in DOE-wide directives but shall be used to assign local responsibilities and authorities and prescribe additional procedures unique to a particular organization.

11. REQUESTS FOR COPIES OF DIRECTIVES. Requests for copies of directives by Headquarters organizations, after initial distribution, shall be forwarded to the Distribution Section, MA-234.23. Telephone requests will also be accepted at 252-9642 and 252-2226. Field organizations should order directives from established stockrooms.

WILLIAM S. HEFFELFINGER
Director of Administration

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CHAPTER I

GENERAL

1. TYPES OF DIRECTIVES.

a. Orders are issuances used for permanent or long-lasting directives. A directive, regardless of the number of addressees, should be issued as a permanent one if it establishes a permanent organization, delegates authority, states a permanent policy, contains an approved procedure, prescribes a method, or establishes standards of operation. The format for Orders is illustrated by this directive. Related instructions are provided in Chapter II. Orders are printed on white paper.

b. Notices are the issuances used for one-time or short-term (1 year or less) instructions and information. Notices may be used to immediately disseminate needed information until it can be incorporated in an Order. The format for Notices may be identical to the format of Orders, except a different form is used for the first page. Brief notices do not require paragraph headings. Notices are printed on blue paper and have an expiration date. Related instructions are provided in Chapter II.

c. Announcements are issued on matters, either personal or informative in nature, i.e., bond drives, consolidated fund drives, first-tier appointments, interim organizations, and the conveyance of messages from the President, the Secretary, or other high Government officials, which are not normally published in internal information organs. The format may be block style if headings are not required, and double spaced if 1 paragraph, or less than 10 lines. Announcements have an expiration date of 3 months or less, and are printed on green paper.

d. Page Changes are transmittals, printed on white paper, used to issue: (1) individual revised pages to replace existing pages; and/or (2) additional pages covering new, related material. Notices and Announcements are not changed by these means. On those few occasions when Notices and Announcements require change, they should be replaced by a new issuance. Chapter III outlines the format of a Page Change.

2. EXPIRATION DATES. Temporary policies and procedures, and the one-time dissemination of general information, such as appointments, have no continuing reference value. In accordance with FPMR 11.3, they shall remain in effect for a limited, fixed period of time and contain the date on which they are removed from the system. The "expiration date" on Notices and Announcements is the mechanism used within the Department to reduce the volume of material retained in the directives system.

3. CLEARANCE.

a. Before any directive is finally approved and released, it shall be fully coordinated with all elements substantively concerned with the subject matter. The Departmental Directives Control Point is responsible for determining which elements have a substantive interest in proposed directives and securing their coordination. Clearances will be requested only from those organizations having real interest in the subject. Coordination for information or courtesy reasons is both costly and time consuming and will be avoided. Detailed procedures and requirements are outlined in Chapter V.

b. Failure to respond when requested to coordinate on a directive delays staff action and creates unnecessary workloads. When a response has not been received, or an extension requested by the established deadline, the proposed directive will be processed with the assumption that there are no objections or comments.

c. DOE F 1321.1, "Clearance Record," shall be used for all directives clearances and approvals. Directives requiring formal coordination with any element of the Department will be cleared with the heads of those organizations. Comments and/or rationales for nonconcurring are to be attached to the signed and dated form and returned to the analyst listed as contact point. Memorandums shall not be used. DOE F 1321.1 should be signed rather than initialed. Responsibilities of coordinating organizations are outlined in Chapter V.

4. RESPONSIBILITIES AND PROCEDURES. Figure I-1 is a flow chart outlining the various authorities, responsibilities, and procedures involved in processing a directive from its inception until publication. Originating organizations forward the proposed directive to MA-213.1 by a transmittal which includes as much information as necessary, including recommended coordinators, and attaches applicable background information.

a. Typing.

(1) Each directive (Order, Notice, Announcement, Page Change), consisting of 1 paragraph, or less than 10 lines, should be double spaced. Triple space between paragraphs when double spacing is used. Assurance that the directive is in the prescribed format for publication on the appropriate forms is the responsibility of the initiating office. This office is designated the Office of Primary Interest.

(2) The alphabetical designation and the first four digits of the directives number shall be filled in (see Chapter VII).

(3) The word D R A F T and the date will be typed under the number block.
Example: D R A F T .
1-28-82

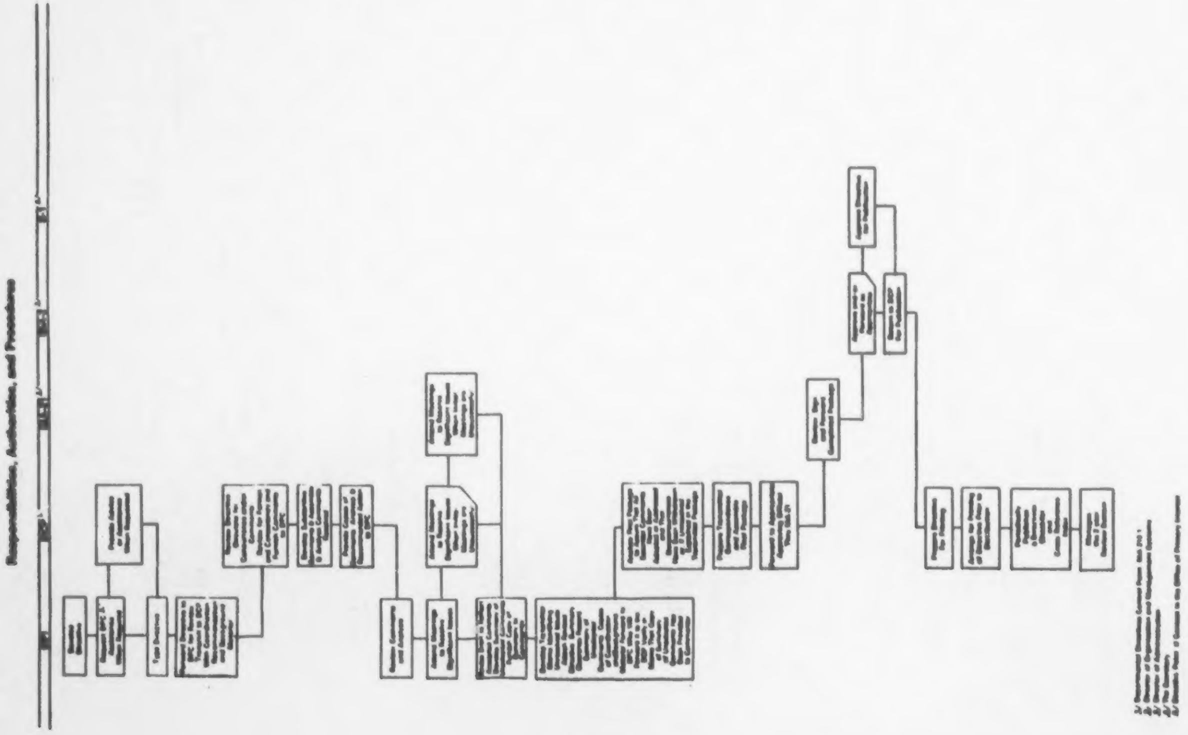


Figure 1-1
Flow Chart

(4) The "Distribution" and "Initiated by" sections at the bottom of the form shall be completed.

(5) An original and three copies of the draft directive shall be forwarded through or by the DPC to the Directives and Federal Register Branch, (MA-213.1), for appropriate action.

(6) Correctness of format, spelling, and punctuation is the responsibility of the originating organization.

b. Word Processing. Where word processing technology exists, it should be utilized for the preparation of directives to eliminate repetitive typing when revisions are required. This applies to adopting comments and updating directives.

c. Coordination. Detailed guidance is contained in Chapter V. In summary, the Director of Administration, through the Departmental Directives Control Point, arranges for appropriate coordination; i.e.:

(1) Reviewing, on request, draft directives, providing preliminary advice and assistance as appropriate;

(2) Circulating draft directives to interested DOE Elements for concurrence and/or comment; and

(3) Reviewing, analyzing, and assembling comments received for potential problem areas, and providing copies of the comments and recommended action to the originating organization. Substantive comments and/or editorial comments relating to format and consistency may also be provided during the coordination process.

d. Originating organizations review comments and the recommended action and revise the draft directive to reflect accepted comments.

e. Originating organizations return the revised directive (original and three copies) through or by the DPC to the Directives and Federal Register Branch, together with an identification of nonconcurrences not resolved and/or essential comments not adopted, and the reasons for the nonresolution and/or nonadoption; summary Clearance Records (see page V-5, Figure V-2); and copies of the Clearance Records and comments received.

NOTE: If the revised directive is not returned to MA-213.1 within 3 months from the date it was transmitted to the OPI for final action, further actions will require recoordination. If no action is taken by the OPI during a 6-month period, the pending file retained in MA-213.1 will either be returned to the OPI or destroyed.

f. The DPC assembles the final package for submission to the Departmental Directives Control Point. The package shall include:

(1) A transmittal Memorandum which contains a statement of nonconcurrences not resolved and/or comments not adopted, with the reasons for nonresolution and/or nonadoption.

(2) A completed summary Clearance Record (page V-5, Figure V-2) reflecting who concurred or nonconcurred, and who offered comments, with an indication as to whether comments were or were not adopted. The summary is typed on the original, signed Clearance Record. Typographical errors and noticeable corrections, such as those made with correction fluid, are not permissible on Clearance Records forwarded to the Secretary. Correction tape shall not be used on Clearance Records. Information typed on the summary Clearance Record shall be an exact duplication of what appears on the signed DOE F 1321.1.

(3) Directive in final form (original and three reproduced copies).

(4) Copies of all comments received.

(5) Any other background information necessary to complete the package.

g. The final package will be submitted to the approving official by the Departmental DCP (MA-213.1), through the Director of Organization and Management Systems (MA-21).

h. The Director of Administration, MA-2, will resolve any differences with the originating organization. If not resolved, an explanation of these differences will be included with the package referred to in paragraph 4f above.

i. After final approval by the appropriate official, the directive will be returned to the Departmental DCP where arrangements for printing and distribution will be made.

5. DIRECTIVES IDENTIFICATION. The alphabetical prefix and the first four digits of the directive's subject classification code are assigned by the OPI (see Chapter VII). The Departmental DCP inserts the date, final digit(s), and letter designation, if appropriate, on all directives after they have been approved. The date of the directive is the date of signature by the approving authority. Numbers and dates for directives internal to a single organization are inserted by the originating organization (see page I-7, paragraph 13).

6. SIGNATURE BLOCK AND SEAL. The signature block and facsimile seal are added by the Departmental DCP after the approving official has signed the Clearance Record. (See page II-11, paragraph 14.)

7. PRINTING OF DIRECTIVES. The Departmental DCP arranges for the printing of Departmental directives.

8. DISTRIBUTION OF DIRECTIVES. The OPI determines which organizations should receive directives and indicates this in the "Distribution" block of the directive. The recipient organizations determine the quantities of the directives they should receive. The Division of Printing and Graphics, MA-234, makes an annual request of Headquarters and field organizations to review requirements for directives, and maintains distribution lists. The Distribution Section makes distribution according to requirements established by originators and users of the directives. Chapter VIII contains detailed instructions for originators to identify the intended audience, and users to identify their requirements, for directives.

9. REPRINTING OF DIRECTIVES. The Distribution Section, MA-234.23, Office of Administrative Services, maintains stocks of DOE directives and makes distribution according to established requirements. The OPI determines whether or not directives should be reprinted. See Chapter VIII for responsibilities and procedures.

10. CHANGING AND CANCELING DIRECTIVES.

   a. Notices contain an expiration date which is usually 1 year or less. Announcements contain an expiration date which is usually 3 months or less. Orders are automatically reviewed after 2 years (see Chapter X). The Departmental DCP will give the initiating organization advance notification of the automatic review date so that appropriate action can be taken. The OPI will then either take steps to update and extend the provisions of such directives for a longer period of time, or cancel them by a Notice. Reviews, updates, cancellations, and extensions are the responsibility of the OPI.

   b. Directives may be altered by issuing a complete replacement for the directive or, in the case of Orders, by issuing selected revised pages as substitutes for existing pages (see Chapter III). Completely revised directives are handled as new directives. The standards for issuing changes are, with respect to coordination and approval, the same as for new directives.

   c. Directives also may be canceled by the issuance of another directive specifically identifying the directive to be canceled. This may be done either in a replacement directive or by a Notice issued specifically for the purpose of canceling the basic directive. Directives may only be canceled at the request of the OPI.

   d. After publication, recipient organizations discovering an error, or believing there is need for a revision, should notify the OPI in writing and send a copy of the correspondence to the Departmental DCP, MA-213.1. Within 10 working days the Departmental DCP shall receive from the OPI either a Page Change, revised directive, cancellation Notice, or a copy of the OPI's response on why the change is inappropriate.

   e. As for new directives, the typing of Page Changes, cancellation Notices, and revised directives is the responsibility of the OPI.

11. CHECKLISTS. The Departmental DCP will issue a listing by alphabetical prefix, subject classification code, date, and subject of each directive in effect as of a specified date. This checklist will be issued in Notice format at least twice a year. More frequent publication will be made if warranted.

12. FORMS.

a. Forms required by this Order are:

(1) DOE F 1321.1, "Clearance Record."

(2) DOE F 1321.2, "Order."

(3) DOE F 1321.3, "Notice."

(4) DOE F 1321.4, "Announcement."

(5) DOE F 1321.5, "Page Change."

(6) DOE F 1321.6, "Directive Typing Guide - Odd Page."

(7) DOE F 1321.7, "Directive Typing Guide - Even Page."

b. All the above forms are available from established stockrooms or contractor-operated supply facilities located in DOE buildings.

13. DIRECTIVES INTERNAL TO A SINGLE ORGANIZATION.

a. General.

(1) Letter prefixes (routing symbols) will be used by each organization to identify internal directives (see Chapter VII). Such directives shall not be designated DOE or HQ directives.

(2) Care will be exercised to assure that subject matter covered applies only to the organization of origin. These directives may not be circulated outside the originating organization.

(3) Such directives will be controlled by internal control points, rather than the Departmental DCP.

(4) Internal control points will assign the directives identification, including sequential numbers. Numbers will be assigned in accordance with Chapter VII, except that letter prefixes will be the alphabetical portion of routing symbols. For example, the first internal Order concerning legal opinions issued by the General Counsel would be identified as GC 2010.1.

b. Approval. Internal directives may be approved by the Heads of Departmental Elements, and, to the extent delegated by these officials, heads of organizations reporting directly to them.

c. Printing. Requests for printing are prepared by the originating organization. The internal directives control point performs the same functions for internal directives as those peformed by the Departmental DCP in the case of DOE directives. Internal directives shall be printed in colors different from those used for the Departmentwide system.

CHAPTER II

DIRECTIVES FORMAT

1. PURPOSE. To describe the standards for preparing Orders, Notices, and Announcements.

2. REQUIRED FORMS. DOE F 1321.2 shall be used for the first page of each Order, DOE F 1321.3 shall be used for the first page of each Notice, and DOE F 1321.4 shall be used for the first page of each Announcement. DOE F 1321.6 and DOE F 1321.7 shall be used for all succeeding pages, including tables of content and attachments.

3. TYPE FACE. Type face similar to that used in this Order (letter gothic 12-pitch) should be used. Elite type shall not be used for directives.

4. COPIES. An original and three reproduced copies are required by the Departmental Directives Control Point, MA-213.1. *Changes to existing directives which are being revised should be highlighted on an additional copy.*

5. FORMAT. The format of this Order shall be used as a guide in preparing directives. Detailed instructions are contained in this chapter. As outlined on page I-2, paragraph 4a(1), and page II-3, paragraph 10, directives of 1 paragraph, or less than 10 lines, should be double spaced. Triple space between paragraphs when double spacing is used.

6. TYPING AND EDITORIAL RESPONSIBILITIES.

   a. Originating organizations are responsible for typing directives.

   b. Originating organizations are responsible for format, spelling, and punctuation.

   c. MA-213.1, during the second DCP process shown in Figure I-1, shall review for format and consistency, and furnish comments to the Directives Point of Contact.

   d. Originating organizations are responsible for making corrections.

7. TYPING REQUIREMENTS.

   a. The rectangular box in the upper right corner of the required forms is reserved for the alphabetical prefix and the subject classification code. The DOE or HQ designation and first four numbers are filled in by the OPI. Additional letters are required to identify Notices and Announcements as outlined in Chapter VII. The word D R A F T and the date will be typed under the rectangular box. The date is changed for each succeeding draft revision. Example: D R A F T.
   1-28-82

b. The preparing organization completes the "Subject," "Distribution," and "Initiated by" elements of the forms. Following the word "Subject" insert a descriptive one-line title for the directive in all capital letters. Longer titles should be used only when essential for clarity. After "Initiated by" insert the organizational title of the office of primary functional interest in the substance of the directive. Do not use abbreviations. See Chapter VIII for essential instructions on completion of the "Distribution" element of the DOE directives forms.

c. The Departmental DCP completes the remainder of the forms after final approval by inserting the final digit(s) and letter designation, if appropriate, in the upper right corner, inserting the date of approval immediately below the rectangular box, typing in the signature block of the approving authority, and affixing a facsimile of the Departmental seal. The Departmental DCP also enters the expiration date of Notices and Announcements immediately following the word "Expires." This date is usually 1 year from the date of the Notice, and 3 months from the date of the Announcement.

8. MARGINS AND INDENTATIONS. The basic format changes from odd to even pages only to the extent necessary for reference and binding purposes. Since odd pages and even pages are printed back-to-back, the margins are adjusted for hole punching.

a. Margins. Each directives form contains blue, nonreproducible vertical lines as guides for the right and left margins, and subparagraphing. Each form also contains a nonreproducible, horizontal broken line at the bottom as a signal to the typist that only two or three more lines may be typed on the page. On the first page of directives, line up the left and right margins with the beginning and ending of the preprinted lines just under the "Subject" line. Succeeding pages are typed on DOE F 1321.6 and DOE F 1321.7. Typists should be careful to keep the text within established margins. The left margins are 1 inch wide on odd and one-half inch wide on even pages. The right margins are the reverse--one-half inch on odd pages and 1 inch on even pages. The first page of a directive is typed on the appropriate DOE form as outlined on page II-1, paragraph 2.

b. Indentations. Paragraph and subparagraph indentation and blocking shall be as illustrated in this directive.

c. Text. Begin typing the text on the second line below the preprinted line just under the "Subject" line on the first page. On succeeding pages, start the text 1-1/2 inches from the top of the page. Leave at least 1-1/2 inches at the bottom of all pages, and 3-1/2 inches at the bottom of the last page of the basic directive so that the signature block may be typed in after the directive has been approved.

9. DIRECTIVES IDENTIFICATION, DATE, AND PAGE NUMBERS. The directive identification (alphabetical prefix and first four numbers) shall be typed by the

OPI on all pages of DOE and HQ directives. The page number is always shown on the outside of the page for easy finding. Hence, on odd-numbered pages the page number is on the right margin, and on even-numbered pages on the left margin. The directives identification and date are switched from left margin to right margin to accommodate this change. The sequential identification numbers and date of signature are typed by the Departmental DCP.

10. STANDARD PARAGRAPHS. Brief Notices and Orders consisting of 1 paragraph, or less than 10 lines, shall be typed in double-spaced, block style format. Standard paragraphs for Orders, and for Notices consisting of more than two pages, in the sequence they are to be used, are as follows:

a. Purpose. Each directive requiring standard paragraphs shall have as its first paragraph a "PURPOSE" paragraph which briefly describes the subject matter and effect of the directive.

b. Cancellation. In this paragraph identify, by classification number, subject (in all capital letters), and date, all existing directives canceled by the issuance of the directive. When used, this paragraph shall always be the second paragraph. The format of the cancellation is as follows: DOE 0000.0, CANCELED ORDER, of 3-13-86.

c. Scope.

(1) The scope of a directive is based on applicability of the directive to organizational elements and not the scope of the function(s) identified within the directive. Normally, the scope of a directive can be determined by the text and identifying alphabetical designation. Generally, DOE-prefixed directives apply throughout the Department, and directives applicable only to Headquarters organizations are identified by HQ. Some examples of exceptions, which require "SCOPE" paragraphs, are as follows:

(a) In instances where a directive is not applicable to all Departmental Elements, or is applicable to a specific audience, a statement is included to identify those organizations covered in the scope of the directive. Example:

> "The provisions of this Order apply to the Assistant Secretary for Nuclear Energy, the Assistant Secretary for Defense Programs, and all Operations Offices."

(b) In instances where the directive is applicable to contractors such applicability shall be identified in the scope of the directive. When the directive is applicable to operating and onsite service contractors, the directive will be implemented by field organizations responsible for administering the contract. When needed for other contracts, or specific categories of contracts, contract articles shall be developed, coordinated with the Chief of Procurement Policy, MA-421.1, and included in the contract in order to implement the directive. Example:

> "The provisions of this Order apply to all Departmental Elements and contractors performing work for the Department as provided by law and/or contract and as implemented by the appropriate contracting officer."

(2) The "SCOPE" paragraph shall be the second paragraph of a directive unless there is a cancellation. In this event, the "SCOPE" paragraph shall be the third paragraph.

d. Effective Date. Unless otherwise specified, directives are effective on approval. When a directive is effective on a date other than the approval date, a special paragraph headed "EFFECTIVE DATE" will be inserted.

e. References. Always make each directive as complete as possible. Restrict references to items needed by the user to understand the contents of a directive. Make sure any reference cited is readily available to the reader, and do not reference drafts, or planned, or temporary directives. If a directive makes reference to material not available to the user, the initiator should arrange for distribution of the referenced material and include availability information. Generally, references should be listed by identification letters and/or numbers, the subject or title, and the date of publication. Briefly explain what each reference does. Example: DOE 0000.0, REFERENCED MATERIAL, of 3-3-82, which outlines the Department's policy. . . .

f. Definitions. Include definitions only when needed to identify new or nonstandard terminology, or when beneficial to the users of the directive.

g. General Content.

(1) Delegations of Authority. Delegations of authority shall be published in the Department of Energy Organization Manual, and as appropriate, in the "Federal Register." Such delegations may then be referred to in individual directives.

f. Definitions. Include definitions only when needed to identify new or nonstandard terminology, or when beneficial to the users of the directive.

g. General Content.

(1) Delegations of Authority. Delegations of authority shall be published in the Department of Energy Organization Manual, and as appropriate, in the "Federal Register." Such delegations may then be referred to in individual directives.

(2) Dates. When writing dates within a directive they should be in numerical format; e.g., 10-13-82.

(3) Subjects. Capitalize the subjects of directives in lieu of using quotation marks.

(4) Cross-Referencing. When referencing another portion of the same directive not on the same, preceding, or following page, the page and paragraph number, without spaces or punctuation, should be used as follows:

(a) Page 4, paragraph 4a(3); or

(b) Page II-3, paragraph 6c(1)(b).

(5) Titles.

(a) When first writing an organizational title it should be written with the routing symbol following it; e.g., Director of Organization and Management Systems (MA-21); Inspector General (IG-1). Routing symbols may be enclosed by parentheses or commas.

(b) The correct format for titles is contained on page VIII-1 of DOE 1325.1A. Generally, titles relate to functional responsibilities rather than organizational levels which are denoted by routing symbols.

Examples:	Correct:	Chief of Systems Software (MA-251.1)
	Incorrect:	Chief, Systems Software Branch (MA-251.1)
	Correct:	Director of Printing and Graphics (MA-234)
	Incorrect:	Director, Division of Printing and Graphics (MA-234)

(6) Capitalization.

(a) Capitalize "Department" and "Departmental" when referring to DOE.

(b) Capitalize "Administration," "Agency," or "Department" when referring to a Federal unit, whether in the full name or used alone as a short form of a specific proper name."

(c) Capitalize "DOE Elements" and "Departmental Elements."

(d) Capitalize "Heads of Field Organizations" and "Heads of Departmental Elements."

(e) Capitalize "Government," "Federal," and "Federal Government" when used as a part of proper names, as proper names, or as proper adjectives.

(f) Capitalize the titles of forms such as Order, Notice, Announcement, Page Change, and Clearance Record.

(g) For the purpose of emphasis, apply the rule of common nouns used alone as a well-known short form of a specific proper noun, and capitalize chapters, attachments, and figures when number designations are included; e.g., Chapter III, Attachment 1. This exception shall be limited to directives.

(7) Abbreviations. For reading ease use only well-known abbreviations or acronyms. If it is desirable to use an abbreviation or acronym, spell out the word or phrase followed by its abbreviation or acronym in parentheses. Example: Department of Energy (DOE). After this first definition of its meaning, the abbreviation or acronym may be used without further explanation. The word or phrase may also be used. Abbreviations and acronyms shall not be used in the "Subject," "Distribution," or "Initiated by" portions of the directive. Whenever possible, the use of an abbreviation or acronym in a heading should be avoided.

(8) Underlines (Underscores). Underlining is used for emphasis and loses effectiveness when overused. Underlines shall be used for all headings and then restricted to words for emphasis. Underlines are unbroken and not used under ending punctuation.

(9) Numerals. The "GPO Style Manual" should be referenced for the rules on use of numerals. In accordance with the "GPO Style Manual," generally numbers from one to nine are written out, and figures are used for larger numbers, with the exception of the first word of the sentence. Further exceptions are:

(a) When numbers are used in a group, any one of which is 10 or more, the sentence will be regarded as a unit for the use of figures, and numerals shall be used. Example: Petroleum came from 16 fields, of which 8 were discovered in 1956.

(b) Unless used as the first word of a sentence, units of measurement, time, or money are always expressed in figures. This does not affect the use of figures for other numerical expressions within a sentence. Examples:

1 The amount of fuel was estimated at 5 gallons.

2 The time of the meeting is 3 p.m.

3 The cost is 75 cents, but will increase to $1.10.

4 Three gallons of gasoline will last for 54 miles.

(c) Percentage is usually written with the number in figures and the word "percent" in lieu of the "%" symbol. Examples of this, with exceptions shown in parentheses, are outlined below. Examples:

1 12 percent;

2 25.5 percent;

3 0.5 percent (or one-half of 1 percent);

4 (50-50) [colloquial expression]; and

5 7 percentage points.

(10) Footnotes. Footnotes shall be avoided and are restricted to attachments and figures. (See page II-11, paragraph 13i, for discussion.)

(11) Forms. Blank forms may be referenced in the body of a directive, with a notation of where they may be obtained. Forms attached to a directive shall be filled in as examples.

11. SUBDIVISION OF DIRECTIVES.

a. Paragraphs. The basic unit of a directive is the paragraph. Each paragraph may be a single block unit of text or, as in this case, subdivided into subparagraphs. Each subparagraph may be subdivided into still lower level subdivisions. When a paragraph is subdivided, it must have at least two subdivisions. All paragraphs within Orders require a number or letter designation.

b. Subparagraphs.

(1) When subdivisions are used anywhere within a page, they are designated as follows:

1. ....
    a. ....
        (1) ....
            (a) ....
                1 ....
                    a ....

(2) After the number or letter designation, subparagraphs begin with capital letters. Each of a series of short subparagraphs may be punctuated with a semicolon, except for the last sentence which is punctuated with a period. (See page II-7, paragraph 10g(9)(c), for an example.) Commas are not used at the end of the next to last subparagraph ("GPO Style Manual"). Lengthy subparagraphs should be punctuated with periods.

c. Chapters, Parts, and Sections.

(1) Normally, paragraphs and subdivisions of paragraphs are all that is needed in writing directives. However, in a long directive (see page II-11, paragraph 15) it may be necessary to group paragraphs into larger units. When this is necessary, use chapters; e.g., CHAPTER I, GENERAL INFORMATION; CHAPTER II, CONTROL; CHAPTER III, OVERALL DEPARTMENTAL RESPONSIBILITIES; and CHAPTER IV, PROCEDURES.

(2) Chapter designations are centered at the top of the page. Each chapter begins on a separate odd page. Titles are centered two spaces under the chapter designation. Both are underlined.

(3) It is also permissible to subdivide chapters into sections or consolidate several sections into parts in exceptional circumstances. For example, a comprehensive organization manual could be subdivided under Chapter I, Organization, as Part A - Headquarters, and Part B - Field, with separate sections devoted to each applicable organization under Parts A and B, such as Section 1 - Office of the Secretary.

d. Figures and Attachments. Tabular or other nonnarrative information is identified as a figure if inserted in running text, or as an attachment if attached to the directive or a chapter as a separate body of information. Attachments also may be used to separately treat detailed procedures, illustrate forms filled in as examples, or reproduce excerpts from legislation or other published documents. (Documents available from other sources should not be reprinted as part of a directive.) Whenever possible, attachments should be in the same format as the directive, and include headings, paragraphs, and subparagraphs, as outlined in paragraphs 11a and b above.

12. HEADINGS. All chapters, parts, sections, paragraphs, attachments, and figures shall be given brief, descriptive headings. Use this directive as an example.

a. Chapters, parts, sections, and attachments require center headings at the top of the page, which are typed in all capital letters.

b. The headings for figures are typed in initial capital letters and centered under the figure.

c. Paragraphs require side headings which are typed in all capital letters.

d. Subdivisions of paragraphs should be given headings (initial capital letters) if reading and reference would be improved thereby.

e. All headings are underlined.

13. NUMBERING AND LETTERING PROCEDURES.

a. Tables of Content pages are numbered with lower case Roman numerals.

b. Chapters are numbered in a straight Roman numeral sequence.

c. Parts are identified by capital letters.

d. Sections are numbered in straight Arabic numeral sequence.

e. Pages. Use the page numbering of this directive as an example.

(1) Pages are numbered in straight Arabic numeral sequence, unless an Order is long enough to be divided into chapters.

(2) When chapters are required, pages are identified by the chapter and the page number; e.g., VI-1, VI-2, and each chapter is numbered in a separate sequence.

√ (3) Pages of each attachment are numbered in a separate sequence under the attachment designation discussed in subparagraph 13h below, if attached at the end of a directive. When attachments are part of individual chapters, they are identified by the next odd page number of that chapter. See subparagraphs 13e(5)(c) and (d) below for examples.

(4) The pages of each figure are numbered as part of the text.

(5) The front and back of each page must be accounted for. This assures the reader that a blank page does not indicate a misprint. If the back of a page will be blank, include both numbers on the odd page, as follows:

(a) 5 (and 6);

(b) III-5 (and III-6);

(c) Attachment 1
Page 1 (and 2); or

(d) Attachment V-1
Page V-11 (and V-12).

(6) The first page of major segments (i.e., table of contents, parts, sections, chapters, attachments) will be typed on an odd page (DOE F 1321.6).

(7) Blank pages may be reserved for future use when it is determined that it will be beneficial. This procedure shall be restricted to large documents separated by chapters, or frequently changed attachments. Reserved pages are denoted as follows:

(a) II-5 (thru II-16); or

(b) Attachment 4
Page 6 (thru 10).

(8) The last page number designation is always an even number.

f. Paragraphs are numbered in a straight Arabic numeral sequence.

g. Subdivisions of Paragraphs are alternately numbered and lettered at each level of subordination as illustrated on page II-8, paragraph 11b.

h. Attachments and Figures are titled and numbered in a straight Arabic numeral sequence; e.g., Attachment 1, Attachment 2; Figure 1, Figure 2. In instances where chapters are involved and there are several attachments or figures, chapter identification may also be included and each set of attachments or figures for each chapter are numbered in a separate sequence. Example: Figure II-1, Figure II-2; Attachment III-1, Attachment III-2.

l. Footnotes shall be avoided and are restricted to attachments and figures. When used, number consecutively in the following format: 1/, 2/, 3/. Numbers shall appear 1/2 space above the appropriate text matter and in sequence under the figure. Footnotes to attachments are listed at the bottom of the page.

14. SIGNATURE BLOCK AND SEAL. The signature block and facsimile seal are placed on the directive by the Departmental DCP after the approving official has signed the Clearance Record. In accordance with FPMR 11.3 (see the basic Order, page 1, paragraph 4b), the approval signature "need only show on the clearance form," which is a complete record of all signatures for a particular directive.

15. LONG ORDERS.

a. Since directives that are simple to identify provide an accurate and easy means of reference, and directives that are simple to use help the reader and speed operations, *Long Orders are discouraged*. Information contained in a large document is often difficult to locate or may be overlooked because of the volume of words surrounding it. In addition to being hard to use, large documents require much effort to revise. The smaller document is simple to keep current and this helps to eliminate error. In the Departmental system, individual directives of similar subject content are linked together by the subject classification code and filed in the same looseleaf binder. This allows:

(1) Grouping separate directives according to subject by interfiling;

(2) Easily amending individual pages and removing obsolete ones; and

(3) Distributing selectively so that applicable parts (in lieu of one large document) can be sent to specific points.

b. In select instances, consolidating all like information into one document is necessary for the convenience of the users. An example of this is the Correspondence Manual where one action on the part of the user would frequently require information from multiple chapters; e.g., "Congressional Correspondence," "Coordination," "Correspondence Control," "Models of Address," "Preparation of Envelopes," "Capitalization," and "Punctuation."

c. When the need for a single, lengthy document is determined, for the convenience of users and originators, it is better to use book-type (manual) publication format instead of the conventional format. Usually the book-type format is desirable when an Order exceeds 30 pages, although sometimes somewhat shorter Orders can be improved by this treatment. In such cases:

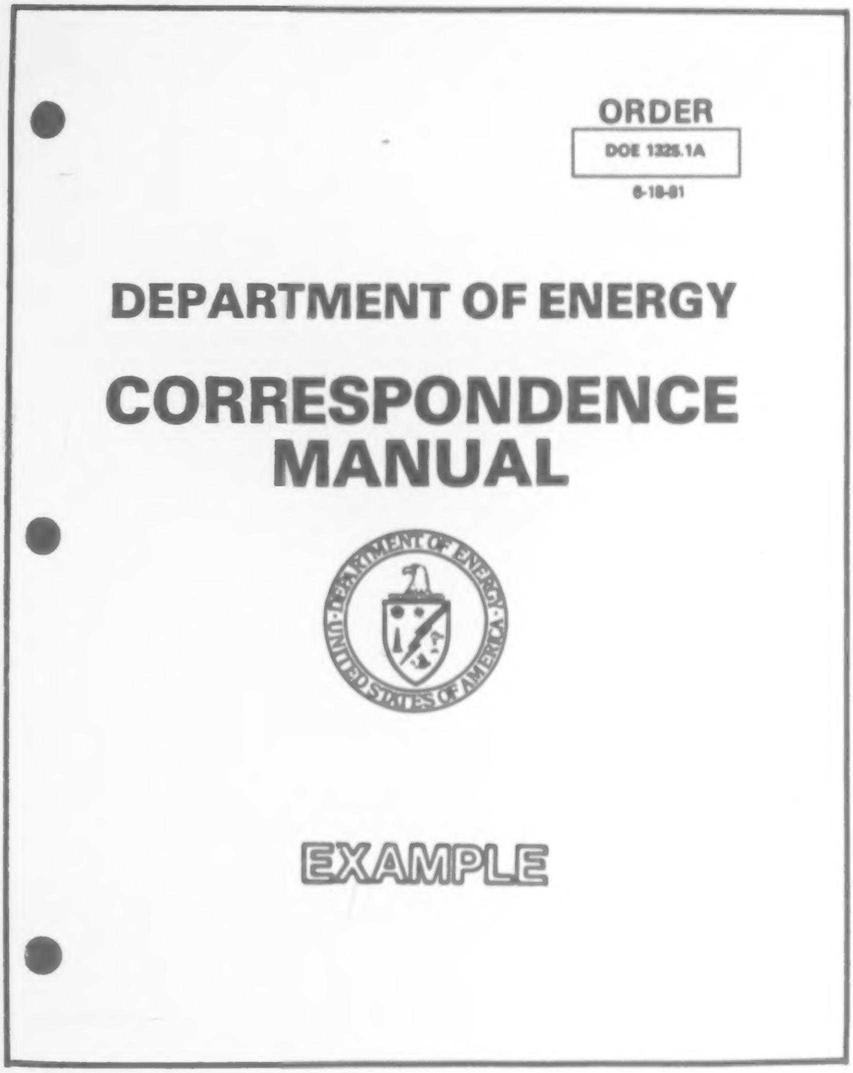
(1) A special cover page must be prepared for book-type Orders. This contains the Order number, date, subject, facsimile seal, and the words "United States Department of Energy," or "Department of Energy." Attachment II-1 is an example of a properly prepared cover page.

(2) Prepare, as the first page (which will face the back of the front cover), a basic Order containing the relevant standard paragraphs. (See page II-3, paragraph 10, regarding standard paragraphs.)

(3) Prepare a table of contents listing each chapter, section, part, paragraph, figure, and attachment in the sequence that they fall in the succeeding text. If figures can be more easily identified by separating them from the primary listing, they may be listed at the end of each chapter listing. Set the table of contents up on one or more separate sheets following the last page of the basic Order. Number the table of contents at the top of the page with lower case Roman numerals. Use the table of contents for this Order as an example.

(4) Start the text at the top of a new odd page following the table of contents. Divide the text into chapters, parts, sections, paragraphs, and subparagraphs, as appropriate. (Although this directive has not been published as a manual, it does follow the requirements of subparagraphs 15c(2), (3), and (4), and may be used as an example.)

COVER PAGE



ORDER

DOE 1325.1A

6-18-81

DEPARTMENT OF ENERGY

CORRESPONDENCE
MANUAL

EXAMPLE

CHAPTER III

PAGE CHANGE

1. PURPOSE. To give the standards and instructions for the use of a Page Change.

2. REQUIRED FORM. Use DOE F 1321.5, "Page Change," to transmit new or revised pages.

3. CRITERIA. Use revised pages to update an Order when this is the most economical way of making an Order current. Generally, a complete revision (reprint and reissue) of an Order is best when an Order is four pages or less in length and any single page must be reprinted. Individually changed pages issued as substitutes for existing pages are usually best on longer Orders when half or less of the pages must be reprinted to update the Order. Also, Page Changes are used to transmit additional pages to existing Orders. Page Changes are not used for Notices or Announcements. (See page I-1, paragraph 1d.)

4. PREPARATION OF NEW AND CHANGED PAGES.

   a. Retype existing pages exactly as they were printed and distributed, except for the specific text that is to be changed. Pages printed on the reverse of the changed page must be included.

   b. Using a fine point, black ink pen, mark revised text for quick identification by drawing a vertical line in the left margin, starting with the first line and continuing to the bottom of the last line of the text being revised. This may mean two or three separate vertical lines on a single page in some cases. Vertical lines should be carefully marked since they also indicate deletions when extended between typed lines or paragraphs. At the bottom of each changed page type: "Vertical line denotes change." (See page III-8 for an example.)

   c. When revised text adds to the total length of the Order, it may be necessary to add additional pages. To do this, prepare the additional page following an even numbered page. Number the additional page with numbers and letters; e.g., 4a, 4b, 4c. The use of such designations shall be minimal. The pages shall be renumbered the first time the directive is completely revised.

   d. Do not type a date on pages containing a change. The date will be inserted by the Departmental DCP after the Page Change has been approved for publication. The date at the top of a page denotes the last time the text was changed. It is not used to reflect a change in the placement of text caused by an addition on a previous page. Unchanged pages printed on the reverse of changed pages contain the original date of approval.

When the first page of an Order is changed it will contain the original approval date, as well as the date of the change. Example:

10-13-81
Change 1: 1-28-82

5. PREPARATION OF PAGE CHANGE.

a. Each Page Change carries the same alphabetical and numerical identification, as well as the same subject, as the basic Order.

b. Each Page Change which forwards new or revised pages has, as a minimum, three standard paragraphs ("PURPOSE," "EXPLANATION OF CHANGE," and "FILING INSTRUCTIONS.") In addition, "SCOPE," "EFFECTIVE DATE," and "IMPLEMENTATION" paragraphs may be used if appropriate. The content of these paragraphs, in the order they should appear, is explained below:

(1) The "PURPOSE" paragraph is used to identify the action taken; e.g., "To transmit a revised Attachment 2 to DOE 0000.1A, STANDARD SUBJECT CLASSIFICATION SYSTEM, of 8-14-79."

(2) The "SCOPE" paragraph is defined on page II-3, paragraph 10c, and should only be used if the scope of the change is different from the scope of the published directive. In this instance, a revision to the first page of the Order will be required.

(3) The "EFFECTIVE DATE" paragraph is used to identify a specific date when the changes transmitted become effective. This paragraph is only used when the date is different from that of the Page Change.

(4) The "EXPLANATION OF CHANGE" paragraph is used to explain the specific policy and/or procedural changes contained in the changed pages in a series of subparagraphs. Whenever possible, each item should be cross-referenced to the relevant paragraph of text.

(5) The "IMPLEMENTATION" paragraph is used when it is necessary to give short-term instructions on putting changed policies and procedures into effect. When used, this paragraph follows the "EXPLANATION OF CHANGE" paragraph.

(6) The "FILING INSTRUCTIONS" paragraph identifies each replaced page by number and date, and instructs clerical personnel to remove them, and identifies by number and date the substitute and additional pages attached to the Page Change transmittal. Pages that are changed, as well as those pages printed on the reverse, must be identified in the filing instructions. These instructions also indicate the disposition of the transmittal. An example of a Page Change is shown in the attachments to this chapter.

6. PAGE IDENTIFICATION. When identifying pages to be removed and/or added under the "Filing Instructions," the format is similar to that used for numbering the pages of directives. Various examples are outlined below.

a. When both sides of a page are to be replaced:

Remove Page	Dated	Insert Page	Dated
1 and 2	6-13-82	1 and 2	

b. When one side of a page is replaced:

Remove Page	Dated	Insert Page	Dated
1	6-13-82	1	6-13-82
2	6-13-82	2	

c. When multiple, consecutive pages are replaced:

Remove Page	Dated	Insert Page	Dated
1 thru 8	8-29-82	1 thru 8	

d. When new pages are added:

Remove Page	Dated	Insert Page	Dated
-	-	V-5 thru V-12	

e. When changes involve reserved pages:

Remove Page	Dated	Insert Page	Dated
IV-1	1-28-82	IV-1	1-28-82
IV-2	1-28-82	IV-2	
V-3 (and V-4)	1-28-82	V-3 (thru V-6)	

f. When attachments are involved:

Remove Page	Dated	Insert Page	Dated
Atch 2, page 1	10-13-82	Atch 2, page 1	
Atch 2, page 2	10-13-82	Atch 2, page 2	10-13-82

7. PROCEDURES. The review, coordination, processing, and approval procedures for Page Changes are the same as for new directives.

PAGE CHANGE EXAMPLE

U.S. Department of Energy
Washington, D.C.

PAGE CHANGE

DOE 0000.1A Chg

DRAFT
2-25-83

SUBJECT: STANDARD SUBJECT CLASSIFICATION SYSTEM

---

1. PURPOSE. To transmit revised pages to Attachment 2 of DOE 0000.1A, STANDARD SUBJECT CLASSIFICATION SYSTEM, of 8-14-79.

2. EXPLANATION OF CHANGE. The subject code 1530, Equipment, has been added to the Travel and Transportation category.

3. FILING INSTRUCTIONS.

   a.

Remove Page	Dated	Insert Page	Dated
Atch 2, page 1	8-14-79	Atch 2, page 1	8-14-79
Atch 2, page 2	8-14-79	Atch 2, page 2	

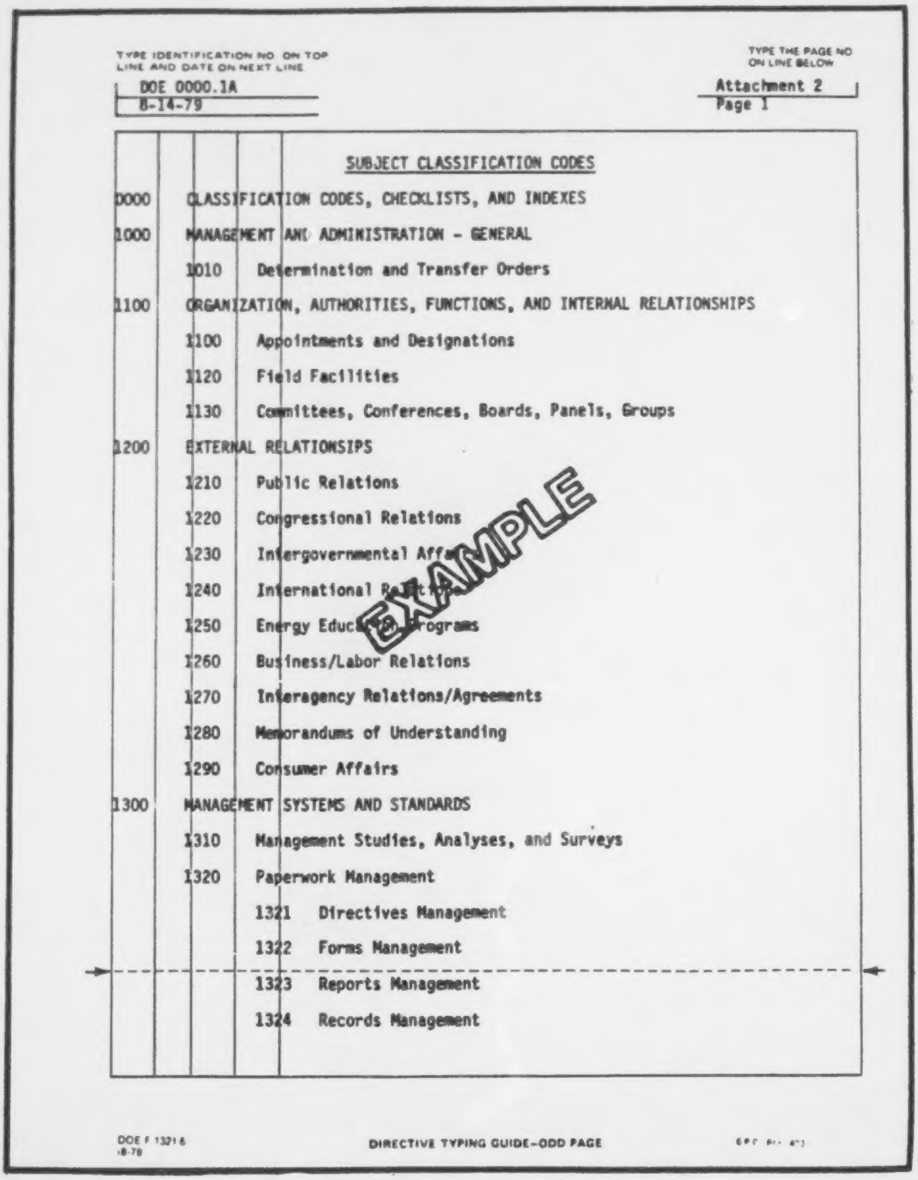
   b. After filing the attached pages, this transmittal may be discarded.

EXAMPLE

DISTRIBUTION:
All Departmental Elements
Federal Energy Regulatory Commission

INITIATED BY:
Office of Organization
and Management Systems

UNCHANGED PAGE



TYPE IDENTIFICATION NO. ON TOP LINE AND DATE ON NEXT LINE

DOE 0000.1A
8-14-79

TYPE THE PAGE NO. ON LINE BELOW

Attachment 2
Page 1

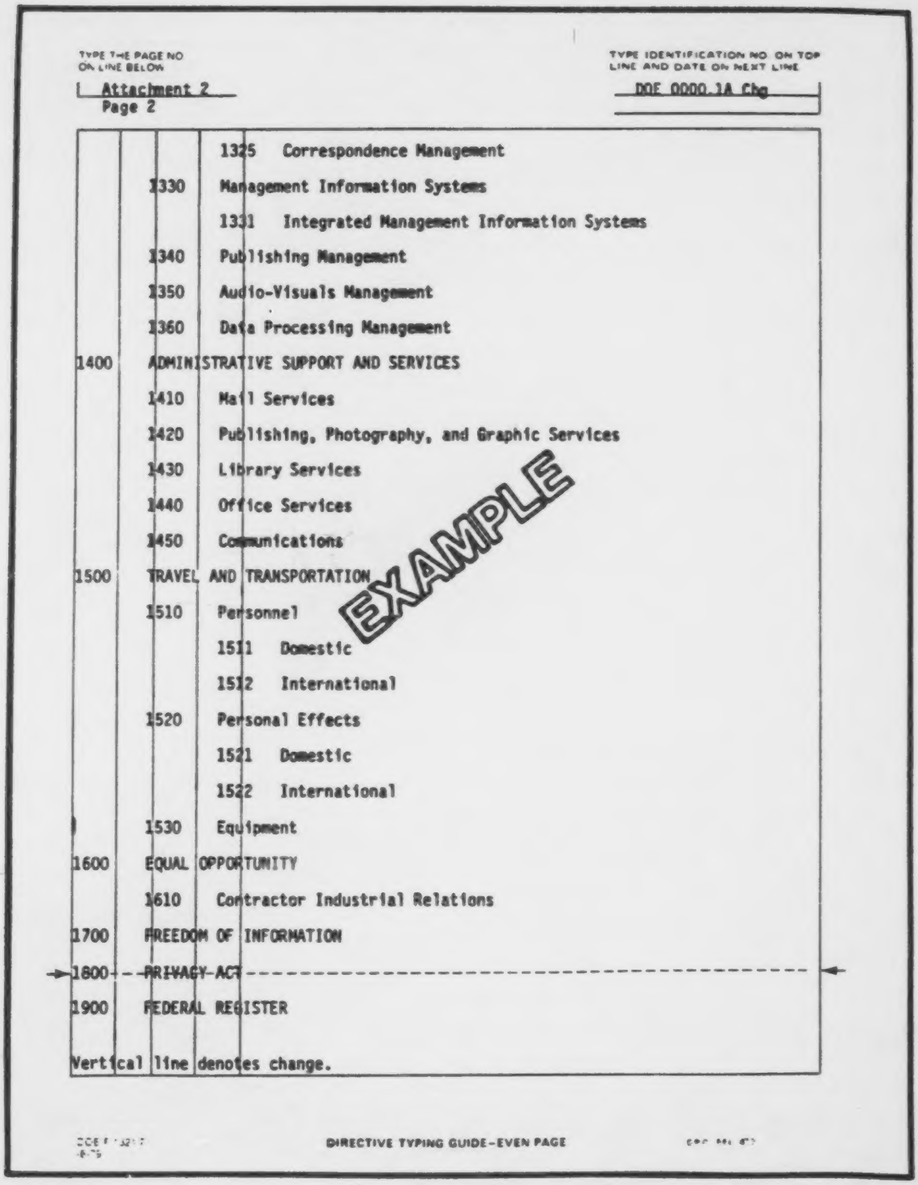
SUBJECT CLASSIFICATION CODES

0000 CLASSIFICATION CODES, CHECKLISTS, AND INDEXES
1000 MANAGEMENT AND ADMINISTRATION - GENERAL
  1010 Determination and Transfer Orders
1100 ORGANIZATION, AUTHORITIES, FUNCTIONS, AND INTERNAL RELATIONSHIPS
  1100 Appointments and Designations
  1120 Field Facilities
  1130 Committees, Conferences, Boards, Panels, Groups
1200 EXTERNAL RELATIONSIPS
  1210 Public Relations
  1220 Congressional Relations
  1230 Intergovernmental Affairs
  1240 International Relations
  1250 Energy Education Programs
  1260 Business/Labor Relations
  1270 Interagency Relations/Agreements
  1280 Memorandums of Understanding
  1290 Consumer Affairs
1300 MANAGEMENT SYSTEMS AND STANDARDS
  1310 Management Studies, Analyses, and Surveys
  1320 Paperwork Management
    1321 Directives Management
    1322 Forms Management
    1323 Reports Management
    1324 Records Management

DOE F 1321.6
(8-79)

DIRECTIVE TYPING GUIDE-ODD PAGE

CHANGED PAGE



TYPE THE PAGE NO ON LINE BELOW

TYPE IDENTIFICATION NO. ON TOP LINE AND DATE ON NEXT LINE

Attachment 2
Page 2

DOE 0000.1A Chg

1325 Correspondence Management
1330 Management Information Systems
1331 Integrated Management Information Systems
1340 Publishing Management
1350 Audio-Visuals Management
1360 Data Processing Management
1400 ADMINISTRATIVE SUPPORT AND SERVICES
1410 Mail Services
1420 Publishing, Photography, and Graphic Services
1430 Library Services
1440 Office Services
1450 Communications
1500 TRAVEL AND TRANSPORTATION
1510 Personnel
1511 Domestic
1512 International
1520 Personal Effects
1521 Domestic
1522 International
1530 Equipment
1600 EQUAL OPPORTUNITY
1610 Contractor Industrial Relations
1700 FREEDOM OF INFORMATION
~~1800 PRIVACY ACT~~
1900 FEDERAL REGISTER

Vertical line denotes change.

DIRECTIVE TYPING GUIDE-EVEN PAGE

CHAPTER IV

EDITORIAL MARKS

1. PURPOSE. Standard editorial marks shall be used to simplify the review and typing of directives. A variety of editing styles, received during coordination of documents, hinders, rather than helps, the OPIs. Since the purpose of editorial comments (page V-7, paragraph 4b) is to clarify a directive, or to provide constructive suggestions on improving a directive's quality, it is important that the comment be clearly understood. Department-wide standardization will assist in this goal.

2. GENERAL. The following editorial marks were originated by the General Services Administration. Users should be aware that the published list contains some marks not applicable to DOE directives. These marks, directed to printed versus typed documents, are readily apparent.

3. EDITORIAL MARKS. The listing of editorial marks is contained in Attachment IV-1.

EDITORIAL MARKS

	WHAT IS TO BE DONE	MARGINAL NOTATION Showing WHAT is to be done	NOTATION IN TEXT Showing WHERE it is to be done	ILLUSTRATION
PUNCTUATION	Insert period	⊙	‸ or /	● press‸ The learned correct
	Insert comma	$\overset{,}{\wedge}$	‸ or /	$\overset{,}{\wedge}$ However/the necessity of a
	Insert apostrophe	$\overset{'}{\vee}$	‸ or /	$\overset{'}{\vee}$ purely printer‸s errors, and
	Insert colon	(:)	‸ or /	(:) of the following‸ pencils,
	Insert semi-colon	;/	‸ or /	;/ other days/ there is no rea
	Insert quotation marks	$\overset{``}{\vee}$ or $\overset{''}{\vee}$	‸ or /	$\overset{``}{\vee}$ $\overset{''}{\vee}$ The word‸not‸was omitted by
	Insert hyphen	=/	‸ or /	=/ open to non‸members only.
	Insert question mark	?/	‸ or /	?/ how will they know/ That is
	Insert exclamation point	!/	‸ or /	!/ a terrific climax/ Naturally
	Insert parentheses	( )	‸ or /	( ) on Page 37‸which see‸ Here
	Insert brackets	[ ]	‸ or /	[ ] "These‸the free-silver Demo
	Insert en dash	$\lvert\frac{1}{N}\rvert$	‸ or /	$\lvert\frac{1}{N}\rvert$ were employed‸men who first
	Insert em dash	$\lvert\overset{1}{-}\rvert$	‸ or /	$\lvert\overset{1}{-}\rvert$ opinion‸their experience will
SPACING	Push down this space	⊥	/	⊥ upon/the best arrangement
	Space evenly	✓✓✓	‸	✓✓✓ I have‸talked‸with‸many a
	Insert space	#	‸	# and almost‸immediately associ
	Less space	‿	‿	‿ one unconsciously‿calls up
	Close up entirely	$\overset{\frown}{\smile}$	$\overset{\frown}{\smile}$	$\overset{\frown}{\smile}$ may be neces sary but, the
	Insert em quad space (indent one em)	□	‸	□ under construction‸Twenty
	Take out character and close up	ꝺ	I	ꝺ they were rather what we
	Take out lead	ꝺ ld	—	ꝺ ld with considerable regularity were previously used on the
	Insert lead between lines	ld>	>	ld> naturally could not be resp state or province as the

	WHAT IS TO BE DONE	MARGINAL NOTATION *Showing WHAT is to be done*	NOTATION IN TEXT *Showing WHERE it is to be done*	ILLUSTRATION
POSITION CHANGE	Move to left	[	⬭	[Life Underwriting
	Move to right	]	⬭	] Life Underwriting
	Lower	⊔	none	⊔ Supply Department
	Raise	⊓	none	⊓ Supply Department
	Paragraph	¶	∧	¶ and of everything.∧It was
	No paragraph	no ¶	none	no ¶ cannot be transferred. A new call must be made
	Transpose letters or words	tr	⊓⊔	tr When branch oprator answer
TYPE	Change defective letter	×	○	× most of them have been proc
	Change to proper style of type (wrong font)	wf	○	wf or could just use the exerc
	Set in capitals	caps	▬	caps the major provisions of the
	Set in small capitals	s.c.	=	s.c. the MAJOR provisions of the
	Set in lower case	lc.	/	lc. the Lower half of the region
	Set in Roman	Rom.	⬭	Rom. the lower half of the region
	Set in Italic	ital	—	ital the lower half of the region
	Set in bold face	bf	~	bf the lower half of the region
	Set in bold face Italic	bf ital	≈	bf ital the lower half of the region
	Use ligature (fi, fl, ff, ffl)	fi	⌢	fi tiring to the fingers. Natu
	Letter upside down; reverse	●	○	● Any operator will have prio
DELETION	Take out; delete	ꝺ	⬭	ꝺ emphasized this this point
	Take out character and close up	ꝺ	⌇	ꝺ emphasiized this point in a
REINSTATEMENT	Retain crossed-out word or letter; let it stand	stet	—	stet that a ~~complete~~ survey can
	Retain only crossed-out words under which dots appear	stet	……	stet ~~when and cost~~ removed from

CHAPTER V

CLEARANCE AND APPROVAL PROCEDURES

1. GENERAL.

a. Clearance is the process used to complete staff work prior to final approval of a directive and is obtained through coordination with all elements having a substantive interest in the subject matter. Approval is the final step in the process of authorizing publication of directives.

b. Preliminary Informal Discussions.

(1) Very often preliminary informal discussions before requesting clearances will pave the way for, and simplify, the formal coordination process. This is particularly true in instances where there are disagreements or issues to be resolved.

(2) The preliminary process is a mechanism for program counterparts to exchange viewpoints prior to drafting a directive. It is not a clearance process and shall not be done by formal correspondence between heads of organizations.

(3) The preliminary process does not eliminate the need for formal clearances by the Departmental Directives Control Point, MA-213.1.

(4) To facilitate formal clearances, informal discussions between counterparts in the Department are encouraged.

c. Responsibilities.

(1) The Departmental Directives Control Point is responsible for coordinating all directives.

(2) The initiating organization can, and should, recommend coordinators in the transmittal correspondence. The initiating organization may also recommend no coordination if the proposed directive is the result of Executive order, Public Law, or other such document, or if it is informative in nature and does not require action or impose a workload. The final decision will be made by the Departmental DPC.

(3) After coordination, it is the responsibility of the initiating organization to meet with coordinating organizations and attempt to resolve significant issues (nonconcurrences). The Information Management Systems Branch, MA-213.1, may be consulted, or asked to sit in, at any stage of the meetings by any participant. Since this organization makes final recommendations to the signature authority, a member of this staff, and/or a member of the Office

of Organization and Management Systems, shall be in attendance at all meetings held between coordinating organizations and the OPI when initial meetings do not resolve all issues.

(4) It is the responsibility of the OPI to notify the commenting organization of all essential comments not adopted, and the rationale therefor. The format for this procedure is discussed on page V-4, paragraph 2b(3).

2. PROCEDURES.

a. Coordination.

(1) Coordination of directives shall be accomplished by the use of DOE F 1321.1, "Clearance Record." This form is completed and transmitted by the Departmental DCP, to organizations having a substantive interest in the proposed directive.

(2) Directives requiring formal coordination with Departmental Elements shall be addressed to the heads of such elements.

(3) Responses may be made by anyone within each organization who has been given the authority. Only one consolidated response will be accepted from each organization.

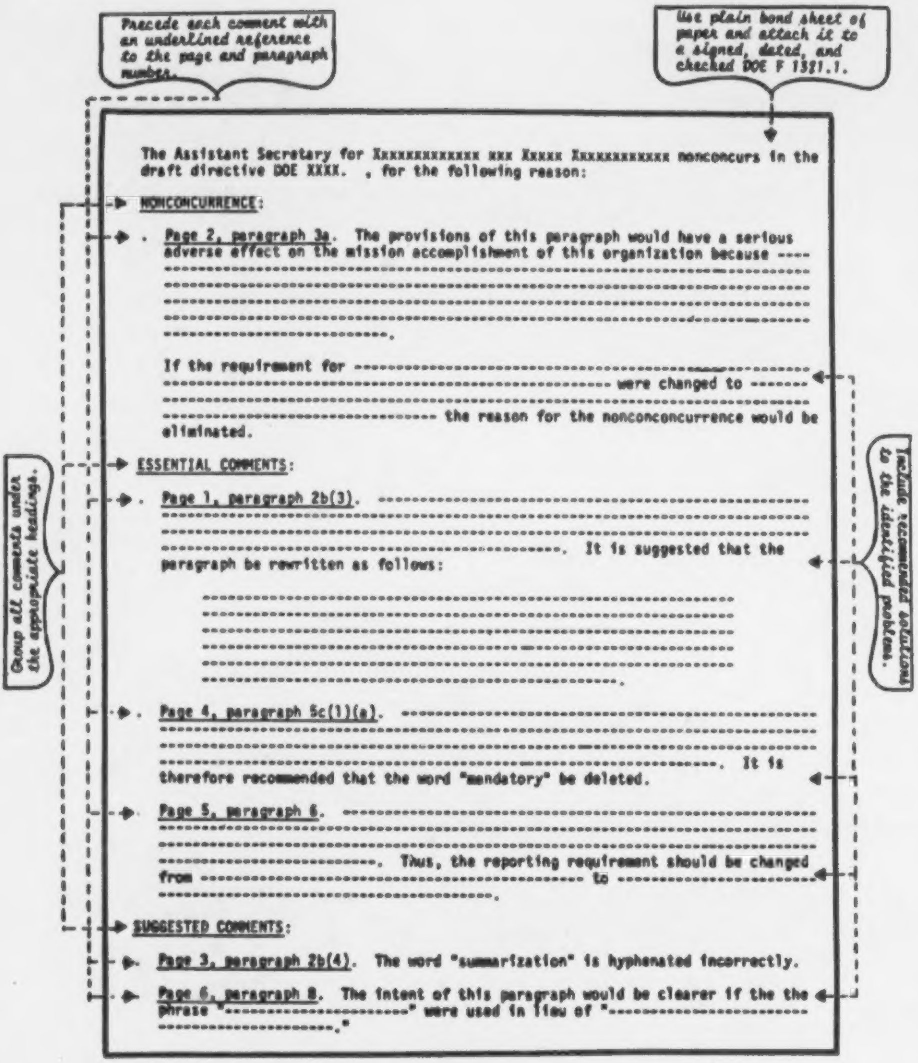
(4) DOE F 1321.1 shall be used for making all responses. Failure to sign (not initial), date, check, and return this form impacts in several ways, the most important of which is that a nonconcurrence may be addressed as a concurrence with comment unless the appropriate block on the form is checked. In addition, the information at the top of the form is used to identify the directive, and route it promptly to the appropriate analyst. Without this information, there could be a significant routing delay.

(5) Coordinating officials:

(a) Respond by signing in the "Signature" block next to their title, filling in the date, and checking the appropriate "Concur" or "Nonconcur" block.

(b) Submit comments and/or nonconcurrences typed on plain bond paper. (See Figure V-1.)

(c) Precede each comment with an underlined reference to the appropriate page and paragraph number from the directive. Example: "Page 5, paragraph 6a(4). The requirement that . . . ."



Precede each comment with an underlined reference to the page and paragraph number.
Use plain bond sheet of paper and attach it to a signed, dated, and checked DOE F 1321.1.
Group all comments under the appropriate headings.
Include recommended solutions to the identified problems.

The Assistant Secretary for Xxxxxxxxxxxx xxx Xxxxx Xxxxxxxxxxx nonconcurs in the draft directive DOE XXXX. , for the following reason:

NONCONCURRENCE:

- Page 2, paragraph 3a. The provisions of this paragraph would have a serious adverse effect on the mission accomplishment of this organization because ---.

  If the requirement for -- were changed to -- the reason for the nonconconcurrence would be eliminated.

ESSENTIAL COMMENTS:

- Page 1, paragraph 2b(3). --. It is suggested that the paragraph be rewritten as follows:

  --.

- Page 4, paragraph 5c(1)(a). --. It is therefore recommended that the word "mandatory" be deleted.

- Page 5, paragraph 6. --. Thus, the reporting requirement should be changed from -- to --.

SUGGESTED COMMENTS:

- Page 3, paragraph 2b(4). The word "summarization" is hyphenated incorrectly.

- Page 6, paragraph 8. The intent of this paragraph would be clearer if the the phrase "--------------------" were used in lieu of "--."

Figure V-1
Comment/Nonconcurrence Format

(d) Group all comments under headings which appropriately identify them as nonconcurrences, essential comments, or suggested comments.

(e) Assure that comments and/or nonconcurrences are attached to the signed DOE F 1321.1 and returned to MA-213.1.

(f) When possible, include recommended solutions to the problems identified by the comments.

(6) Comments shall not be memorandums addressed to other individuals, since this creates additional delays and does not allow for oversight to assure that the procedures of this Order are followed.

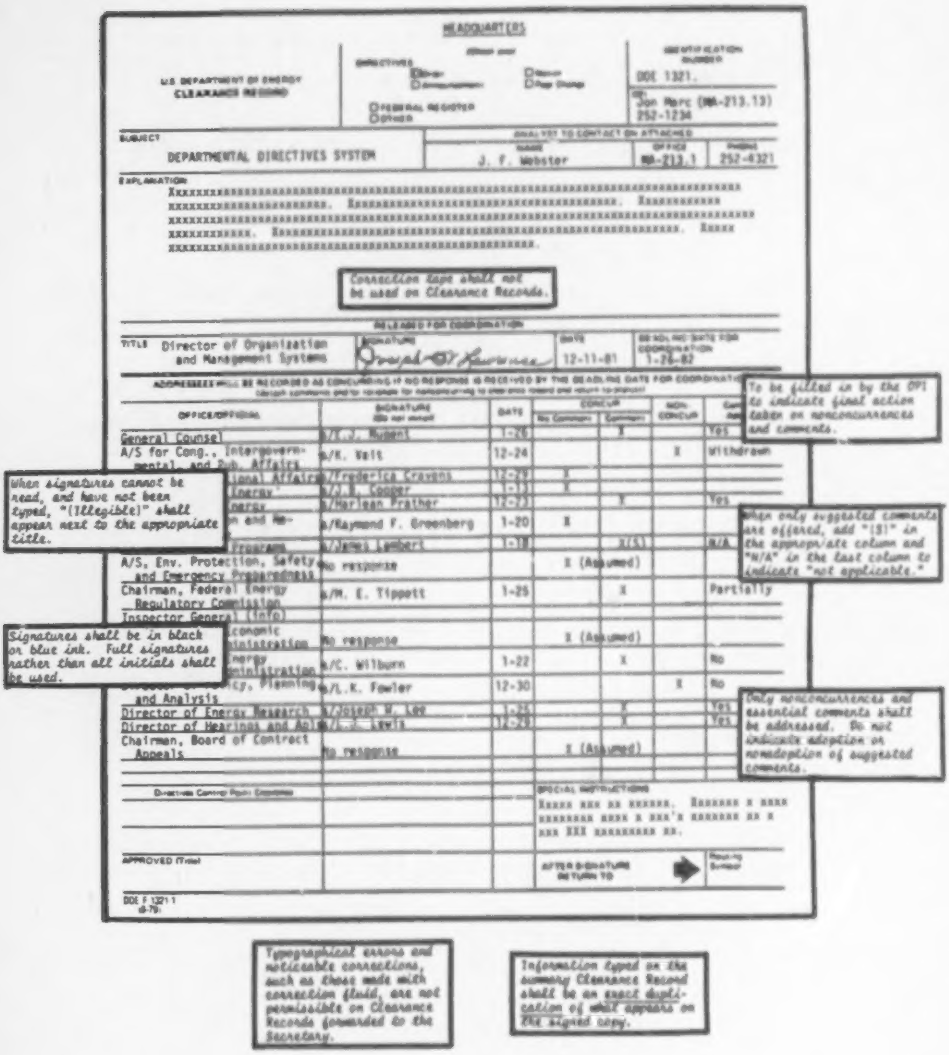
(7) Signatures shall be in black or blue ink. Full signatures, rather than all initials, shall be used. (Examples: "R. F. Greenberg" or "Raymond F. Greenberg" but not "R.F.G.") If the signature cannot be easily read, the name, as signed, shall be typed on the next line. Position titles or words such as "for" shall not be included. When signatures cannot be read, and have not been typed, the word "(Illegible)" will appear next to the organization title on the summary Clearance Record transmitted to the signature authority (Figure V-2).

b. Adoption and Resolution of Comments.

(1) As noted on page V-1, paragraph 1c(3), meetings shall be held in an attempt to resolve significant issues (nonconcurrences). When all reasonable efforts to resolve disputed issues are not successful, the OPI shall submit the proposed directive with a concise, but clearly explained, summarization of the pros and cons, by organization, to MA-213.1. Nonconcurrences may be addressed in the transmittal memorandum or the format outlined in Figure V-3 on page V-5.

(2) The summary of unadopted comments (Figure V-3) is required for all essential comments that have not been adopted. This shall also be a concise, but clearly explained, summarization of the pros and cons, by organization. The comments are copied verbatim, including the page and paragraph references, with the rationale for nonadoption typed next to them.

(3) As outlined on page V-2, paragraph 1c(4), it is the responsibility of the OPI to inform commenting organizations when their essential comments will not be adopted, and the reasons therefor. This is done by sending the Directives Point of Contact in the commenting organization a copy of the rationale for nonadoption at the same time that it is transmitted to MA-213.1 The DPC of the commenting organization is responsible for circulating the summary within their organization to the appropriate commenters. It is not necessary to notify commenting organizations that comments have been adopted. There is no requirement to address unadopted suggested comments. Verification that the



HEADQUARTERS

U.S. DEPARTMENT OF ENERGY
CLEARANCE RECORD

DIRECTIVES ☒ Order ☐ Announcement ☐ Notice ☐ Page Change
☐ FEDERAL REGISTER
☐ OTHER

IDENTIFICATION NUMBER: DOE 1321.

Jon Marc (MA-213.13)
252-1234

SUBJECT: DEPARTMENTAL DIRECTIVES SYSTEM

ANALYST TO CONTACT ON ATTACHED: NAME J. F. Webster | OFFICE MA-213.1 | PHONE 252-4321

EXPLANATION
Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxx. Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx. Xxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxx. Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx. Xxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx.

Correction tape shall not be used on Clearance Records.

RELEASED FOR COORDINATION

TITLE: Director of Organization and Management Systems | SIGNATURE: Joseph W. Lawrence | DATE: 12-11-81 | DEADLINE DATE FOR COORDINATION: 1-26-82

ADDRESSEES WILL BE RECORDED AS CONCURRING IF NO RESPONSE IS RECEIVED BY THE DEADLINE DATE FOR COORDINATION

OFFICE/OFFICIAL	SIGNATURE (Do not initial)	DATE	CONCUR No Comment	CONCUR Comment	NON-CONCUR	
General Counsel	s/T.J. Nugent	1-26		X		Yes
A/S for Cong., Intergovernmental, and Pub. Affairs	s/K. Valt	12-24			X	Withdrawn
...ional Affairs	s/Frederica Cravens	12-29	X			
...Energy	s/J. B. Cooper	1-13	X			
...nergy	s/Marlean Prather	12-23		X		Yes
...n and Re-	s/Raymond F. Greenberg	1-20	X			
...Programs	s/James Lambert	1-18		X(S)		N/A
A/S, Env. Protection, Safety and Emergency Preparedness	No response		X (Assumed)			
Chairman, Federal Energy Regulatory Commission	s/M. E. Tippett	1-25		X		Partially
Inspector General (Info)						
...conomic ...inistration	No response		X (Assumed)			
...nergy ...inistration	s/C. Wilburn	1-22		X		No
...icy, Planning and Analysis	s/L.K. Fowler	12-30			X	No
Director of Energy Research	s/Joseph W. Lee	1-25		X		Yes
Director of Hearings and Ap...	s/[illegible] Lewis	12-29		X		Yes
Chairman, Board of Contract Appeals	No response		X (Assumed)			

Directives Control Point Clearance

SPECIAL INSTRUCTIONS
Xxxxx xxx xx xxxxxx. Xxxxxxx x xxxx xxxxxxxx xxxx x xxx'x xxxxxxx xx x xxx XXX xxxxxxxxx xx.

APPROVED (Title)

AFTER SIGNATURE RETURN TO | Routing Symbol

DOE F 1321.1
(8-79)

To be filled in by the OPI to indicate final action taken on nonconcurrences and comments.

When signatures cannot be read, and have not been typed, "(Illegible)" shall appear next to the appropriate title.

When only suggested comments are offered, add "(S)" in the appropriate column and "N/A" in the last column to indicate "not applicable."

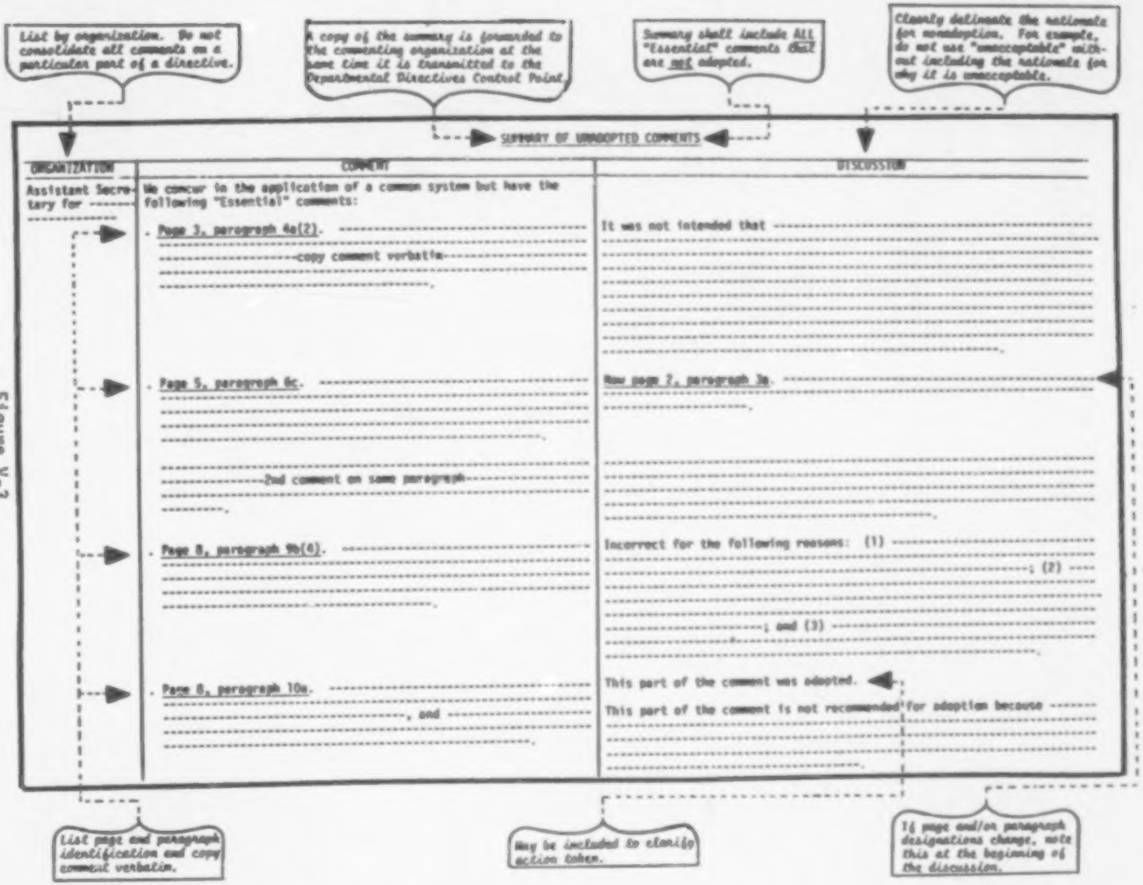
Signatures shall be in black or blue ink. Full signatures rather than all initials shall be used.

Only nonconcurrences and essential comments shall be addressed. Do not indicate adoption or nonadoption of suggested comments.

Typographical errors and noticeable corrections, such as those made with correction fluid, are not permissible on Clearance Records forwarded to the Secretary.

Information typed on the Summary Clearance Record shall be an exact duplication of what appears on the signed copy.

Figure V-2
Summary Clearance Record



List by organization. Do not consolidate all comments on a particular part of a directive.

A copy of the summary is forwarded to the commenting organization at the same time it is transmitted to the Departmental Directives Control Point.

Summary shall include ALL "Essential" comments that are not adopted.

Clearly delineate the rationale for nonadoption. For example, do not use "unacceptable" without including the rationale for why it is unacceptable.

List page and paragraph identification and copy comment verbatim.

May be included to clarify action taken.

If page and/or paragraph designations change, note this at the beginning of the discussion.

SUMMARY OF UNADOPTED COMMENTS
ORGANIZATION
COMMENT
DISCUSSION
Assistant Secretary for
We concur in the application of a common system but have the following "Essential" comments:
Page 3, paragraph 4a(2).
copy comment verbatim
It was not intended that
Page 5, paragraph 6c.
New page 2, paragraph 3a.
2nd comment on same paragraph
Page 8, paragraph 9b(4).
Incorrect for the following reasons: (1)
; (2)
; and (3)
Page 8, paragraph 10a.
, and
This part of the comment was adopted.
This part of the comment is not recommended for adoption because

Figure V-3
Summary Format

commenting organization has been sent a copy of the rationale for nonadoption shall be contained in the transmittal correspondence forwarding the final package to MA-213.1.

3. NONCONCURRENCES.

a. Nonconcurrences shall be (1) reserved for instances where a directive in its entirety, or its identified provisions, would have a serious adverse effect on mission accomplishment by the responding element; or (2) directed to the entire concept of a directive. Do not nonconcur for other reasons.

b. Nonconcurrences not meeting the criteria outlined in paragraph 3a shall be addressed as essential comments. (See paragraph 4 below.)

c. Nonconcurrences shall be accompanied by a complete outline of the issues and the substantive reasons for such action.

d. Unresolved nonconcurrences (not adopted to the satisfaction of the commenting organization and not withdrawn in writing) are forwarded to the approving authority for resolution.

4. COMMENTS. Comments may be substantive (essential) or suggested.

a. Substantive comments are those on matters affecting efficiency, economy, mission accomplishment, or other management concerns, and shall be designated as essential. Essential comments require a rationale for nonadoption.

b. Comments made in an effort to avoid an incorrect, unresponsive, or misleading statement shall be designated as suggested. This includes editorial comments which would clarify the directive or provide constructive suggestions on improving its quality. Suggested comments do not require a rationale for nonadoption, unless they are procedural or formatting requirements under the provisions of this Order or other such documents.

c. Comments received without designations will be treated as suggested.

d. All comments shall be preceded by the underlined page and paragraph reference. Example: Page 5, paragraph 6a(4).

e. Unadopted essential comments, and the rationale therefor, are forwarded to the signature authority.

5. CLEARANCE DEADLINES.

a. When field coordination is not required, 10 working days will usually be allowed for clearing directives. When field coordination is required, 30 working days will usually be allotted. When possible, additional time for coordination will be given for long or complex directives.

b. Requests for extensions to the deadline date shall be made to the analyst listed on the Clearance Record, by the Directives Points of Contact, before the actual response date. The analyst shall obtain approval from the OPI. Unless the deadline is imposed by legislation, Office of Management and Budget requirements, or other requirements, reasonable extensions will usually be granted.

c. As stated on page I-2, paragraph 3b, concurrence in proposed directives shall be assumed if comments are not received, or an extension granted, by the deadline date for coordination.

6. APPROVING OFFICIAL ACTION. The entire package, consisting of: a transmittal Memorandum; a summary Clearance Record (Figure V-2); the proposed directive; the summary of unadopted comments (Figure V-3); signed Clearance Records and comments; any directives canceled by the proposed directive; and any applicable background data; is forwarded to the Departmental DCP. This material is then reviewed, analyzed, and forwarded to the approving official (see page I-3, Figure I-1). Unresolved issues are submitted to the approving official for resolution. Unadopted comments are forwarded for review. Final approval is documented by the signature of the approving official on the summary Clearance Record. Directives are not signed but are authenticated by a signature block and seal. (See page II-11, paragraph 14.)

7. POSTAPPROVAL ACTION. After approval, the entire package is returned to the Departmental Directives Control Point (MA-213.1) where the following actions are taken:

a. The final number(s) of the directive identification is(are) assigned.

b. The directive identification and date are typed on all pages.

c. A signature block and facsimile seal are added.

d. A printing requisition is completed, and the approved directive fowarded to the Division of Printing and Graphics, MA-234.

e. The entire case file, including all originals and backup material, is retained by the Departmental Directives Control Point.

CHAPTER VI

DIRECTIVES POINTS OF CONTACT

1. PURPOSE. To establish points of contact in each coordinating organization for the purpose of more effective and efficient use of the Department of Energy directives system.

2. GENERAL. Any directives system, to operate smoothly and efficiently, requires a definite assignment of responsibilities. To effect this, each organization issuing or using directives under the system shall have a central point of contact, or control point, with specific responsibilities. Centralizing the control of directives being coordinated, and providing a centralized, decisionmaking, information point of contact in each organization, assures consistent, effective, and efficient use and guidance.

3. BACKGROUND. The Departmental Directives Control Point, in the Information Management Systems Branch, MA-213.1, develops, installs, and manages the directives system. This organization is the central point for the issuance of all policies and procedures, and is the Departmental liaison between initiating and approving officials. General responsibilities are outlined in Figure I-1, page I-3.

4. RESPONSIBILITIES.

   a. Heads of Departmental Elements are responsible for:

      (1) Designating a Directives Point of Contact;

      (2) Publicizing the designation within the affected organization;

      (3) Assuring that internal staff is aware of the responsibilities of the Directives Point of Contact;

      (4) Encouraging staff to communicate with, and be responsive to, the Directives Point of Contact; and

      (5) Notifying the Departmental Directives Control Point of the name, title, routing symbol, address (including room number and building), and telephone number of the designee, and any changes to the designation.

   b. Directives Points of Contact are responsible for:

      (1) Control of coordination to assure that deadline dates for response are met, or that extensions are requested prior to the deadline date.

(2) Assuring that one consolidated response is submitted by their organization, and when required, holding meetings and reconciling internal divergent viewpoints.

(3) Attending meetings held in an effort to resolve nonconcurrences submitted by their organization, and assuring that either they have the authority to make a decision on the resolution of the issue, or arranging for an official with that authority to be in attendance.

(4) Tracking receipt of, and circulating to commenters within their organization, summaries of unadopted comments when essential comments have been made.

(5) Providing procedural advice to staff members developing or maintaining directives, which requires an indepth knowledge of the system, the procedures, and the format.

(6) Reviewing all proposed directives, prior to forwarding to the Departmental Directives Control Point, to assure that there are no procedural, formatting, spelling, or punctuation errors; to assure that the transmittal correspondence includes all necessary information; and to assure that all background information and the appropriate number of copies are included. DPC's should also assure that changes to existing directives which are being revised are highlighted on an additional copy.

(7) Assuring that proposed directives are returned to the Departmental Directives Control Point for action before the deadlines discussed on page I-4, paragraph 4e.

(8) Assuring that staff members are aware of new policies and procedures as they are published.

(9) Acting as liaison between their organization and the Departmental Directives Control Point.

(10) Requesting assistance from the Directives and Federal Register Branch (MA-213.1), when required.

5. DESIGNATING ORGANIZATIONS.

a. Coordinating Officials, responsible for designating Directives Points of Contact, are:

(1) Secretarial Officers;

(2) DOE Staff Officers; and

(3) Heads of Field Organizations reporting directly to the immediate Office of the Secretary.

Vertical line denotes change.

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b. Field Organizations not included in the preceding listing are encouraged to establish Directives Points of Contact. Although the Headquarters officials to whom they report are responsible for contacting and coordinating with these field organizations, internal processes and procedures will benefit from the establishment of one contact point for directives matters.

c. Headquarters Directives Points of Contact in organizations with field elements are encouraged to establish points of contact in these elements.

6. NOTIFICATION. In order for Directives Points of Contact (coordinating organizations only) to be aware of, and able to contact, each other, a listing including location and telephone number will be published periodically in Notice format. Field organizations not included in the listing are encouraged to publish the information locally.

CHAPTER VII

DIRECTIVES NUMBERING

1. GENERAL DESCRIPTION OF NUMBERING SYSTEM. Each Order, Notice, and Announcement identification is made up of the following components (see paragraph 2 for examples):

   a. An alphabetical prefix, either "DOE" or "HQ" (for the Department of Energy and DOE Headquarters, respectively). All directives which apply only to Headquarters are designated as HQ directives; those that apply beyond Headquarters are designated DOE. Directives which apply within a single organization of DOE are prefixed by the routing symbol assigned to the originating organization.

   b. An additional alphabetical prefix to denote Notices and Announcements. One space will be left between DOE or HQ and the "N" to denote Notice, or the "A" to denote Announcement.

   c. A four digit subject classification code (e.g., 1100, 1630, 5100), which designates the subject area of the directive. (See DOE 0000.1A, STANDARD SUBJECT CLASSIFICATION SYSTEM, of 8-14-79.)

   d. A sequential number to distinguish Orders, Notices, Announcements, and Page Changes from each other within each subject and directive series. Within each series, Orders, Notices, and Announcements are numbered in a straight Arabic numeral sequence. Page Changes are numbered the same as the Order they change, except the abbreviation "Chg" and the appropriate change number are added. Page Changes are not used for Notices or Announcements (see page I-1, paragraph 1d).

   e. In addition, an Order which is completely revised (a complete replacement for an existing Order) retains its original number suffixed with a capital letter ("A," "B,") to distinguish it from previous versions of the Order. For example, the first complete revision of DOE 1000.1 is designated DOE 1000.1A, the second complete revision is designated DOE 1000.1B.

2. EXAMPLES OF DIRECTIVES NUMBERING.

   a. Orders, Notices, and Announcements.

(1)	DOE 1320.1	The first Departmental Order on the subject of paperwork management.
(2)	DOE 1320.2	The second Order on the same subject.

(3) HQ N 1320.1	The first Notice on paperwork management applicable only within DOE Headquarters.
(4) DOE A 1320.1	The first Departmental Announcement on paperwork management.
(5) DOE 1320.1A	The first revision to DOE 1320.1.

b. Page Changes.

(1) DOE 1320.1 Chg 1	The first Page Change issued to DOE 1320.1.
(2) DOE 1320.1 Chg 2	The second Page Change issued to DOE 1320.1.
(3) HQ 1320.1 Chg 1	The first Page Change issued to HQ 1320.1.
(4) HQ 1320.1A Chg 1	The first Page Change issued after the first complete revision of HQ 1320.1.

c. Internal Orders.

(1) GC 1320.1	The first internal Order issued by the General Counsel on the subject of paperwork management. (Internal directives are not circulated outside the originating organization.)
(2) GC 1320.2	The second internal General Counsel Order on the same subject.

CHAPTER VIII

DISTRIBUTION

1. DISTRIBUTION REPRESENTATIVES. Each Departmental Element is responsible for designating a distribution representative and establishing a receiving point for Departmental directives. Changes of either the distribution representative or the receiving point shall be promptly transmitted by Memorandum to the Division of Printing and Graphics (MA-234).

2. RESPONSIBILITIES.

   a. Distribution representatives are responsible for:

      (1) Consolidating total DOE directives requirements for the organization they represent;

      (2) Keeping MA-234 currently advised of their organization's total directives requirements; and

      (3) Performing liaison with the Division of Printing and Graphics.

   b. The organization that initiates a directive is responsible for designating the intended audience. When this determination is made, the distribution is indicated on the first page of the proposed directive. Distribution is then made based on the intended audience and the receiver's requirements (paragraph 2a).

3. DISTRIBUTION DESIGNATIONS. After the initiator determines the distribution for a proposed directive, recipients are indicated in the distribution space at the bottom of the first page of all directives. Examples of designations used to identify the intended distribution for DOE directives follows:

   a. All Departmental Elements. Includes all organizations in Headquarters and the field, except the Federal Energy Regulatory Commission.

   b. All Headquarters Elements. Includes all organizations in Headquarters, except the Federal Energy Regulatory Commission.

   c. All Field Elements. Includes all organizations in the field, except the Federal Energy Regulatory Commission.

   d. Federal Energy Regulatory Commission (RC). When this organization is included in the scope of a directive (see page II-3, paragraph 10c), the Federal Energy Regulatory Commission, and/or the RC Regional Offices, must be listed separately in the distribution space at the bottom of the first page of each directive. When not included in the scope, RC will usually be listed with (info) immediately following the organizational title.

e. All Departmental Personnel. Used when every employee of the Department receives a copy of the directive. This distribution is usually reserved for Notices and Announcements and shall only be used when the contents of the directive must be read by every employee.

f. All Headquarters Personnel. Used when all Headquarters employees, including those in the Federal Energy Regulatory Commission, receive a copy of the directive. This distribution is usually reserved for Notices and Announcements and shall only be used when the contents of the directive must be read by every Headquarters employee.

g. Other Designations. May be needed on occasion to accommodate specific "Scope" paragraphs. In all instances, the contents of the "Scope" paragraph should be used for guidance in designating distribution; e.g., "All Operations Offices."

4. REQUESTS FOR COPIES OF DIRECTIVES.

a. Regular Distribution. A survey form, available from the Distribution Section (MA-234.23), shall be used to obtain regular distribution of directives. The form is structured to allow for automatic data entry, and distribution representatives shall assure the completeness, legibility, and accuracy of the information submitted. The distribution representative is responsible for notifying MA-234.23 of any changes in requirements; e.g., copy requirements and address changes. The survey should be updated regularly, and as a minimum, at least once a year.

b. Copies. Requests for copies of directives by Headquarters organizations, after initial distribution, should be forwarded to MA-234.23, by Routing and Transmittal Slip or Memorandum. Telephone requests will also be accepted at 252-9642 or 252-2226. Field organizations should obtain directives from established stockrooms.

5. MAINTENANCE OF DISTRIBUTION LISTS AND STOCKS.

a. The Division of Printing and Graphics maintains directives distribution lists.

b. The Distribution Section determines stock quantities, and advises the initiator when directives stocks are low. The initiator determines when a directive should be reprinted.

c. As guidance, a frequently used directive, for which no changes are anticipated within 90 days, should be reprinted.

d. When reprinting is indicated, the OPI prepares a printing request and forwards it to the Departmental DCP, along with a copy of the notification received from the Distribution Section.

e. The Departmental DCP attaches the master copy of the directive, and forwards the request to MA-234 for final action.

CHAPTER IX

FILING PROCEDURES

1. BINDERS.

a. Background.

(1) Vinyl looseleaf, three-ring binders, with plastic pockets are available to Headquarters organizations for filing Orders, Notices, and Announcements. Cover and spine inserts, which allow for changes to the numbers as the system grows, are also available. An example of a cover is shown in Attachment IX-I.

(2) Standard 5-cut tabs containing the primary 4-digit numeral and the subject matter are available to separate Orders within the binders. An example of the tabs is shown in Attachment IX-2.

b. Availability.

(1) Headquarters Organizations. Covers and tabs are available in supply outlets. Binders are distributed on an "as needed" basis. Requesting organizations may obtain binders by submitting a DOE Form AD-H34, "Requisition for Supplies, Equipment, or Service," to the Property and Supply Branch, MA-235.1.

(2) Field Organizations. Covers and tabs may be requested from MA-235.1. The expense of purchasing, packaging, and shipping notebooks precludes supplying field organizations directly. Field organizations planning to use the covers and binders should purchase the binders from local sources.

c. Covers.

(1) Headquarters Organizations. Covers for Headquarters organizations consist of one each for DOE Orders, HQ Orders, DOE/HQ Notices, and DOE/HQ Announcements.

(2) Field Organizations. Covers for field organizations consist of one each for DOE Orders, DOE Notices, and DOE Announcements.

d. Tabs.

(1) The preprinted classification tabs shall be used to separate Orders, by number, within the binders. Notices and Announcements are temporary or short-term directives and do not require tabs for reference purposes.

(2) Headquarters organizations should use standard 5-cut tabs, available in supply outlets, to separate DOE and HQ issuances within the Notice and Announcement binders.

e. Restrictions. Binders, covers, and preprinted tabs shall be reserved for the DOE Directives System, and are not available for internal directives, or for other uses.

2. RESPONSIBILITIES.

a. User organizations are responsible for designating employees to maintain sets of directives.

b. Directives Points of Contact in each organization are responsible for assuring that designated employees are aware of the proper procedures for maintaining directives.

c. Organizations shall assure that a complete set of directives is maintained for approximately every 10 employees.

d. Organizations are responsible for determining and requesting the correct quantities of directives for circulating and filing (see Chapter VIII - Distribution).

3. PROCEDURES. Designated employees shall:

a. Insert new directives in the appropriate binders. Orders should be filed behind the tab bearing the same major numerical designation.

b. Assure that canceled directives are removed from the binders. (Note: cancellations are always reflected in the second paragraph of a directive.)

c. Conduct periodic reviews of Notices and Announcements (every 4 to 6 weeks) and remove and discard expired directives.

d. Note, on the upper right corner of directives that have been extended, the number and date of the extending document and change the expiration date to reflect the extension. Example: Extended by DOE N XXXX.X, of 11-5-XX.

e. Post changes to published documents as outlined on the transmittal (Page Change) sheets. Reflect the posting of changes on the upper right corner of the first page of the changed directive, under the date, by adding the number, and publication date. It is not necessary to include the date the change was posted. Example:

1-28-80 (Date of Order)
Change 1: 6-13-81
Change 2: 2-14-82

f. Assure that the binder covers and spine inserts reflect the correct contents and numbers, and are changed and updated as the system grows and additional binders are used.

g. Check all directives against the Directives Checklist (published as a Notice) whenever a new list is published. Discard or obtain directives as required.

h. Post revisions to the checklist as directives are published, canceled, extended, expired, and changed.

i. Circulate one copy of each new directive to the immediate staff.

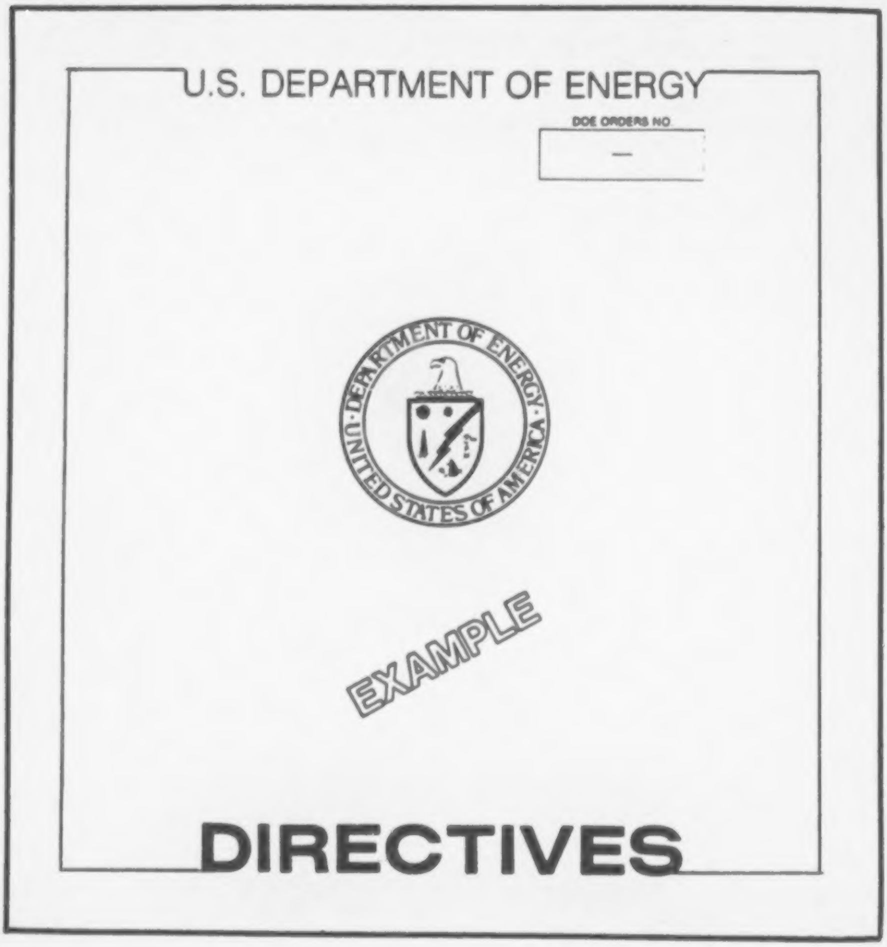
4. ASSISTANCE AND INFORMATION.

a. Designated employees requiring assistance, or having questions, on the filing and maintenance of directives should contact the Directives Point of Contact for their organization. Directives Points of Contact should contact the Directives and Correspondence Management Team Leader, MA-213.12, when further assistance is needed, or when the questions cannot be answered.

b. Questions on distribution should be directed to the Distribution Section, MA-234.23.

c. Questions on binders, covers, and tabs should be directed to the Property and Supply Management Branch, MA-235.1.

BINDER COVER



U.S. DEPARTMENT OF ENERGY

DOE ORDERS NO

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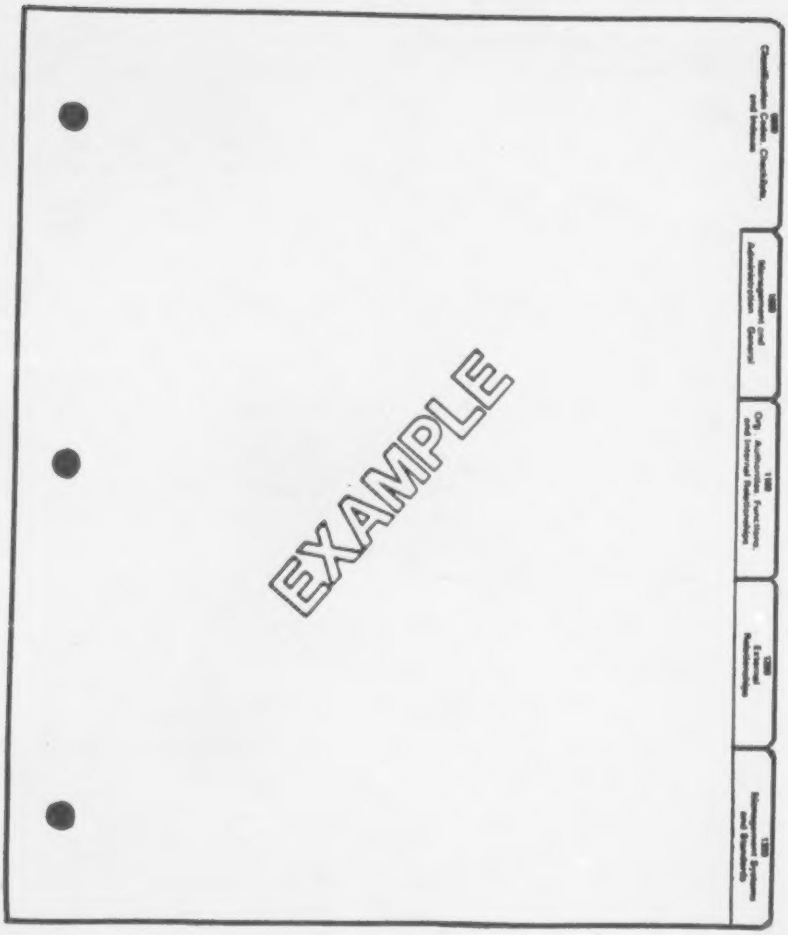
EXAMPLE

DIRECTIVES

TABS


Classification Codes, Checklists, and Indexes
Management and Administration General
Org. Authorities, Functions, and Internal Relationships
External Relationships
Management Systems and Standards
EXAMPLE

CHAPTER X

TWO-YEAR REVIEW SYSTEM

1. PURPOSE. To keep directives current by establishing and maintaining a system to regularly require originators to certify whether to continue, revise, and/or cancel published Orders.

2. BACKGROUND.

   a. In a final rule, published on 11-13-80, the National Archives and Records Service, General Services Administration, expanded the regulations dealing with the standards and guidelines for establishing and managing directives systems. Within this rule is a requirement for originators to review biennially each directive for need and currentness, and for originators to certify whether to continue, revise, or cancel each directive.

   b. The 2-year review system has been part of the Departmental directives system since its initial publication. Procedures and responsibilities are outlined below.

3. PROCEDURES. The system applies only to Orders. Notices and Announcements are temporary directives containing expiration dates and are not subject to 2-year reviews.

   a. The Departmental Directives Control Point, MA-213.1, notifies the Office of Primary Interest (OPI), through the Directives Point of Contact, that a published Order is scheduled for review.

   b. Within 10 working days of the date of the notification, the OPI certifies one of the following actions to MA-213.1:

      (1) The Order is to be updated;

      (2) The Order should be canceled; or

      (3) The Order should be extended without change.

   c. If the Order is to be updated, the OPI shall provide a complete revision or Page Change to MA-213.1 within 30 working days.

   d. If the Order is to be canceled, the OPI shall provide a cancellation Notice to MA-213.1 within 30 working days, along with the reason why the Order is no longer needed.

e. If the Order is to be extended without change, the justification for such action shall be provided MA-213.1.

4. RESPONSIBILITIES.

a. The Departmental Directives Control Point is responsible for:

(1) Managing the 2-year review system; and

(2) Publishing all revisions, cancellations, and extensions in the directives checklist.

b. Directives Points of Contact in each organization are responsible for:

(1) Assuring that all deadline dates are met;

(2) Reviewing all certifications and assuring they are correct;

(3) Assuring that there are no procedural, formatting, spelling, or punctuation errors in proposed revisions or cancellation Notices, and that the correct number of copies are provided; and

(4) Assuring that the transmittal correspondence includes all necessary information.

5. DEADLINE DATES. It is the responsibility of receiving organizations to meet the deadline dates outlined in paragraph 3, or to request a limited extension from the Departmental DCP. Since the requirement for biennial review has been imposed externally, extensions should be requested from MA-213.1 only in exceptional circumstances. If certification and subsequent action are not received by the deadline dates the matter shall be referred to the Director of Administration, who will request appropriate action from the affected Secretarial Officer or DOE Staff Officer.

Question 2. Please describe the opportunities for public comment, for comments by DOE contractors, and comment by DOE and contractor employees and unions representing those employees in the development process.

Answer. The DOE follows the procedures established for the federal agencies when promulgating rules based in statute. Draft rules are published in the Federal Register and comments received from union and contractor employees are considered along with other comments received from the public. The DOE also drafts internal directive called Orders. The Orders are circulated and coordinated among the field offices and secretarial program offices for review/comments; however, the public, contractors, and union are not invited to comment. Orders are considered to be the internal organizational procedures and exclusively a government prerogative. Final orders are available to the public in public reading rooms here in Washington or at each field office. Contractors are provided copies of the orders and other regulations that affect or direct their work pursuant to contract provisions.

Question 3. Please articulate the existing, operative standard or standards of safety for protecting the public from DOE fixed facilities, including production reactors, and from transportation. Please give qualitative and quantitative comparisons to U.S. Nuclear Regulatory Commission, U.S. Environment Protection Agency, and U.S. Department of Transportation Standards.

Answer. With regard to the existing, operative standards or standards of safety for protecting the public from DOE nuclear facilities, including reactors:

DOE 5408.1 establishes the Environment, Safety, and Health (ES&H) Program for DOE Operations;

DOE 5480.4 lists all the ES&H standards utilized by DOE; and,

DOE 5480.5 establishes nuclear facility safety program requirements and DOE 5480.6 establishes reactor safety program requirements to assure that nuclear facilities and reactors are sited, designed, constructed, modified, operated, maintained, and decommissioned in accordance with generally uniform standards, guides, and codes which are consistent with those applied to comparable licensed facilities and reactors. These Orders partially impose the Nuclear Regulatory Commission (NRC) regulatory requirements given in Title 10 Code of Federal Regulations (CFR) upon DOE nuclear facilities and reactors. The program established by these Orders, heretofore, has not included a regulatory enforcement type stance on the part of DOE ES&H organizations. The ES&H program is now evolving into more of an "inspection and enforcement" operation.

With regard to transportation of hazardous materials, substances and wastes, DOE 5480.3 (7/9/85) regulates their storage, packaging, and movement. This Order incorporates by reference 10 CFR 71, "Packaging of Radioactive Material for Transport," promulgated by the NRC. Thus, DOE 5480.3 is consistent with NRC regulations for packaging. Similarly, DOE 5480.3 incorporates 49 CFR 109-199, "Hazardous Materials Regulations," promulgated by the Department of Transporation (DOT), which apply to off-site transportation of hazardous materials, substances, and wastes. Therefore, DOE 5480.3 is also consistent with DOT regulations for off-site shipments of all hazardous commodities, which include radioactive and nonradioactive shipments.

With regard to radioactive shipping containers, DOE certifies containers based upon CFR 71. In addition, some DOE shipping containers also received NRC certification. There are some differences between DOE's and NRC's specific design requirements which are highlighted in the chart below.

DIFFERENCES BETWEEN DOE AND NRC PACKAGING REQUIREMENTS

Requirements	DOE	NRC
Temperature	130F	100F
Penetration	18 lb steel bar	13 lb steel bar
Pressure	25 Psi Gauge	20 psi absolute
	7.35 psi (.5 x std. atmos.)	3.5 psi absolute

With regard to the Environmental Protection Agency, its regulations require Federal agencies to consider the environmental effects of proposed major Federal actions. The environmental effects of the transportation of radioactive commodities has been considered in the 1977 NRC report, NUREG-0170, "Final Environmental Impact Statement on the Transportation of Radioactive Material By Air and Other Modes." This report concluded that the environmental impacts of the normal transportation of radioactive materials, and risks of accidents involving radioactive shipments is sufficiently low to allow shipping by all modes. Further, the NRC stated that transporation under present regulations provides adequate safety to the public. The risks evaluated in that study remain the same today and continue to provide justification for the packaging standards issued by the NRC and their adoption by DOE.

Differences between DOE and NRC regulations are due to DOE's previous practices of incorporating NRC regulations into DOE orders rather than, as is presently the case, adopting the regulations by reference. Minor changes in NRC regulations, either more or less stringent, were not always immediately incorporated into DOE Orders as were all significant NRC regulation modifications.

Question 4. Please describe the process by which the Department of Energy establishes materials production requirements.

Answer. The nuclear materials requirements for the nuclear weapons program are based on the Nuclear Weapons Stockpile Memorandum approved annually by the President. The NWSM is developed jointly each year by the Department of Defense and the Department of Energy based upon requirements of the force structure approved by the Nuclear Weapons Council. The NWSM is submitted to the President after review, analysis and concurrence of the National Security Council.

Question 5. Please describe the Department's record of decision process, including the role of the specific Department officers, in determining that a production facility is safe and in compliance with DOE safety standards prior to operation, during operation, and for restart of operation.

Answer. Since the main concern of the general public is with those facilities that can have major impacts on their health and safety, the answer will deal only with DOE high hazard facilities such as production reactors and plutonium processing facilities.

The DOE Orders require that these facilities prepare safety analyses and design documents which identify and describe the design of the facility, the accidents to which the facility may be vulnerable, the consequences of such accidents (mainly in terms of radiation exposures), and the safety systems and/or administrative controls imposed to prevent or mitigate the consequences of the accident to acceptable levels. Prior to authorization for initial operation or operation following modifications that involve an unreviewed safety question, the safety analyses and design documents are reviewed by the Department's three tiered system. The three tiered overview system includes; first, the contractor program and environmental, safety and health (ES&H) organizations; second the field office program and independent environmental, safety and health organizations; and third, the DOE headquarters line program and ASEH organization. At any or all three layers, independent outside reviews can be performed by experts in particular areas by other DOE laboratories, consultants, or Universities. In addition, the contractor, field office program organization, and independent field office ES&H organization perform Operational Readiness Reviews of the facility to assure that all the safety criteria, systems, and administrative controls that were supposedly designed into the facility and its operation are indeed in place and working.

In regard to restart of operation, after assuring that (1) the safety analyses for the facility have been prepared and satisfactorily reviewed, (2) that an Operational Readiness Review has been performed and that all noted deficiencies to DOE safety standards (Orders) have been corrected, and (3) the facility can be operated safely without undue risk to the health and safety of the general public; the Field Office Manager recommends that the Program Senior Officer (Assistant Secretary for Defense Programs, Nuclear Energy, etc.) approve the authorization for startup of the facility. The Program Senior Officer will provide approval of the authorization for startup of the facility only after concurrence is received from the ASEH.

Although the decision process, as noted above, is in place, there are some problems with its implementation in regard to the type and amount of safety information needed prior to providing authorizations for initial construction and operation. There are two major areas that the ASEH recognizes as needing improvement. They are:

(1) For major system acquisitions and major projects which result in the construction of high hazard facilities, the major acquisition and major project phases are performed in parallel, track with the conceptual and preliminary design phases, and converge at the authorization for initial construction. However, the safety documentation and analysis required to be prepared and reviewed at that time in the authorization process is not adequately defined. The ASEH has undertaken an effort to determine the extent of safety analyses needed to be prepared and reviewed for these facilities prior to initial construction and operation.

(2) The requirements for reactors and nuclear facilities regarding authorization of initial construction, operation, and for startup following major modifications involving an unreviewed safety question include the preparation/review of safety analyses, an independent safety review, and the performance of an Operational Readiness Review. These requirements are specified in the DOE 5480 series Orders (5480 series pertains to ES&H requirements). Although it is clearly stated in the DOE 4700 series Orders (4700 series pertains to major system acquisition and major projects) that environmental assessments and environmental impact statements will be prepared and reviewed, there are no specific or consistent requirements in the DOE 5480 series Orders to prepare, modify or review any of the environmental protection or pollution control documentation as part of these authorizations. The ASEH is presently considering changes to the DOE 5480 series Orders to make them consistent with the DOE 5700 series Orders.

In regard to the decision process during operation of a facility, the contractor, field, and DOE headquarters independent ES&H organizations perform periodic appraisals of the facilities and monitor and track all unusual occurrences (including releases) at the facility. If any of these overview functions observe that the facility imposes any undue risk to the health and safety of the general public, then contractor operations management, the DOE field Manager, or the ASEH may take such action as may be appropriate to ensure safety, including curtailment and suspension of operations. If appropriate action is not taken to curtail or suspend the operation and mitigate the identified danger, the ASEH has the responsibility to advise the Secretary.

Question 6. Please provide the same for a decision that a production facility can, or should, continue to operate if the public risk is above that otherwise established by the Office of Environment, Safety and Health because of production requirements.

Answer. The limiting conditions for operation of any facility are provided in the safety analyses and are called Technical Specifications for reactors and Operational Safety Requirements for nuclear facilities. These limiting conditions identify the limits imposed on the operation of the facilities necessary to meet DOE Order requirements and established standards for radiation does, in particular 10 CFR 100, to assure that the facility is operated without any undue risk to the general public. If any of these limiting conditions are exceeded, the Department has in the past and will not hesitate in the future to curtail or suspend operations as noted in the answer to Question 5 above. Only the Secretary could allow operation of a facility when established limits must be exceeded. That decision was never made in the past nor is it expected in the future.

Question 7. Under the Department's current timetables for the Safety Enhancement Program for the N Reactor, please provide completion dates and total estimated cost of the following:

a. Final installation and acceptance of a hydrogen mitigation system.

b. Final installation and acceptance of improvements in emergency feedwater supplies to the Emergency Core Cooling System and the Graphite Shield Cooling System.

c. Environmental qualification of equipment.

d. Completion of a Level 3 Probabilistic Risk Assessment (PRA).

e. Final installation and acceptance of protection and ventilation improvements for the control room.

Answer. (a) Project H-791, hydrogen mitigation, has a current total estimated cost of $10.3M with a completion date of December 1987. It should be recognized this is based upon a conceptual design estimate, and that once vendor supplied bids for equipment are finalized, a firmer date and cost estimate will be established. Supplemental to hydrogen mitigation, is Project H-798, Hydrogen Monitoring, which is to be completed by August 1987, at a cost of $1.9M. Cost and schedules are firm on this project.

(b) There are three improvements to the Emergency Core Cooling System (ECCS) and the Graphite Shield Cooling System (GSCS). Project H-786, Supplemental ECCS Supply, will be completed by December 1987 at a Total Estimated Cost (TEC) of $1.18M. Project H-766, Alternate ECCS Supply, is in conceptual design, with an estimated completion date during second quarter FY 1991, and a TEC of $12.5M. Lastly, seismic upgrades to the GSCS are underway, funded at approximately $285K, and will be complete by August 1987.

(c) The toal cost anticipated to complete environmental qualification of safety equipment to current commercial industry standards is $50M. Approximately $3M will be spent in FY 1987, developing an implementation plan and categorizing the existing plant equipment. It will take approximately 3 more years to test the equipment (about $17M) and $30M to procure newly certified/qualified equipment. These cost estimates were derived from discussions with industry representatives of facilities of comparable size and age to the N Reactor.

(d) The Level 3 PRA to be developed by Westinghouse-Hanford is scheduled to be issued in final report form by December 1988, at a total estimated cost of $7M, which includes the cost of developing the Level 1 and 2 data, upon which a Level 3 document is based. These costs cover FY 1987–FY 1989 costs.

(e) Ventilation improvements for the control room are part of Project H-544, Control Room Habitability, which has a current TEC of $5.8M, and a completion date of March 1988. The cost estimate and completion date on this project is firm.

Question 8. Please specifiy the criteria and procedure for determining the end of life for the N Reactor including where appropriate, ASME and other codes.

Answer. The end of life for N Reactor is determined to be when the graphite growth exceeds the allowable expansion space available, and the graphite stack starts to touch the biological shield. This is currently projected to be in the early mid 1990's, based upon projected operating schedules, and the technical and analytical data available. The expansion of graphite is slow, predictable, easily monitored, and is only a problem in the peak flux regions. The ongoing surveillance program is monitoring the physical parameters in the reactor core to monitor the expansion progress. Graphite samples have been irradiated in a test reactor that has extended its expsoure beypond that projected foir N Reactor and that data is being utilized in developing a computer model for the stack. In addition to monitoring, safety systems are routinely tested to assure that acceptable performance is maintained, and that performance trends are developed. Since N Reactor process tubes are replaceable, ASME code criteria do not limit the N Reactor lifetime; graphite growth is the life limiting factor.

Question 9. Please specify the same for remaining operational Savannah River Production reactors.

Answer. The Savannah River Plant (SRP) production reactors are operated and evaluated based on the Department of Energy (DOE) orders. Reviews of these SRP reactors have been conducted by onsite DOE personnel, DOE oversite personnel, and consultants since the beginning of their operation. The SRP reactors and their supporting facilities are continually updated and worn equipment either repaired or replaced. No life limiting mechanism has been identified which would reclude safe operation of the SRP reactors. Two years ago a small crack in the reactor tank of the C Reactor was identified. No known repair methodology is currently available, hence, C Reactor has been shut down. The design of the reactors at SRP are different then that of the C Reactor tank and do no have the same region in which the stress corosioncrack developed in the C Reactor tank.

Question 10. Ms. Walker, you mentioned in your statement that your office will be providing updated and improved guidance on safety analysis report preparation. In addition, you stated that your office will be reviewing selected DOE nuclear facilities' safety analysis reports, (a) When will the new guidance be completed and what issues will it address? (b) Which safety analysis reports will be reviewed and when? Given the fact that new guidance will be provided, why isn't your office reviewing all safety analysis reports to assure that they comply with the revised guidance?

Answer. (a) A draft of the safety analysis report preparation guidance was completed in June 1987 and should be finalized by the end of FY 1987.

The guidance will:

amplify the Department's requirements and responsibilities,

define terms and models for evaluating risks, including discussion and explanation of some techniques for hazard identification, accident analysis and risk assessment,

and amplify the docmentation necessary to meet the DOE requirements.

(b) Safety analysis reports for all proposed high hazard facilities and selected moderate hazard facilities will be reviewed by my office. These reports will be reviewed during the project's review and approval scheudle, and my concurrence to start construction or begin operations is required.

For existing facilities, we plan to review all high hazard facilities and approximately one-third of the moderate hazard facilities. There are approximately 40 facilities planned for review. The number of moderate hazard facilities we review may be adjusted upwards or downwards dependent upon what we find in our reviews (i.e., we might end up reviewing all if the results of our initial reviews indicate that this is waranted). At this time, we are looking at completing this in about 3 years. We have initiated reviews of the Plutonium Facility at Lawrence Livermore National Laboratory (LLNL), the Y-12 Uranium Facility at Oak Ridge National Laboratory (ORNL), and the Tritium Facility at Mound Lab.

The above will provide an adequate check on the system and if there are problems in following and/or adhering to the guidance we are preparing, it will be noted in our reviews and we will expand our review effort accordingly.

Question 11. Ms. Walker, you mentioned that you have recently created an Office of Safety Policy to examine DOE's safety policies and requirements to assure their completeness and comparability. What is that office's mandate and timeframe for completing that examination? Please provide any memorandums, reports, or other documents which discuss the creation and functions of that office and its future plans.

Answer. The overall mission of the Office of Safety Policy is to assure a coherent, comprehensive, and consistent approach to the development and implementation of the Department's safety policy. Particular emphasis is given to assuring the comparability of DOE's safety policies and standards with Nuclear Regulatory Commission (NRC), Environmental Protection Agency (EPA), and other national and international authorities in those areas where DOE is not externally regulated. This Office coordinates and maintains overview responsibility for the Department's safety, health and quality assurance orders and their implementation.

As noted, the Office has an ongoing responsibility to review DOE safety orders and assess their completeness and comparability with regulatory standards. In keeping with this function, the Office has been actively involved in reviews of draft orders, policy statements, and new rule development. In the latter case, the Office is currently evaluating the application of new or revised NRC rules to comparable DOE nuclear facilities. With the provision of full staff and budgetary resources in FY 1988, the Office plans to address other policy needs, including more complete analysis of existing safety standards, and development of specific policies to assure comparability with commercial practice, including facility backfit guidance, probabilistic risk assessment guidance, and performance indicator provisions.

Question 12. Ms. Walker, Mr. Morgan stated at the hearing that the C-reactor was operating under the assumptions made in the safety analysis report which makes it acceptable to operate with a leak in the tank wall. In the event of the accidents described in the safety analysis report, what would be the affect of the C-reactor leak? Has the ongoing probabilistic risk assessment or the Reactor Materials Program provided any new information on the operability of the reactors with a crack in the tank wall either during normal operations or an accident situation?

Answer. C Reactor is not operating, as noted in our answer to Question 9, and there is very little new information on the C Reactor problem. The effort over the last year or so has concentrated on low-heat-input welding to repair the leak in order to develop a welding technique that will work on the irradiated material. The results so far have not been very encouraging.

The Office of Environment, Safety and Health has not reviewed the safety of operating the C Reactor with through-wall leaks. Such analysis would need to be completed prior to a proposal to restart the reactor.

Question 13. Ms. Walker, you mentioned that a match on all NRC requirements could not be made. For Savannah River Plant and N-reactor, which requirements could not be met? What are the implications of now meeting these requirements?

Answer. The NRC requirements referenced in Ms. Walker's statement relate exclusively to the General Design Criteria for Nuclear Power Plants that is specified in 10 CFR 50, Appendix A which is applied to the design of new facilities.

As a key element of DOE's Chernobyl response activity, ES&H performed detailed design reviews of the N Reactor and the Savannah River reactors in the May-July 1986 and November 1986 timeframes, respectively. A major objective of these reviews was to address the comparability of these facilities with NRC's General Design Criteria. The differences between NRC criteria and the actual facility capabilities are generally set forth in the reports on the reviews of the designs.

Copies of the individual Design Reviews are attached.[8] These reports define in detail those areas where DOE production reactor safety does not directly meet NRC power reactor requirements. Major areas which have been treated differently in the DOE designs and are discussed in the Design Reviews include:

containment,
seismic criteria,
hydrogen mitigation,
application of National standards, and
emergency core cooling systems and sprays.

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[8] The Design Reviews referred to have been retained in the Committee files.

Question 14. We understand that the C-reactor tank crack began leaking sometime during 1984, but the reactor was not shutdown until July 1985. When was the leak first discovered? Please provide any DOE and contractor memorandums, reports, technical analysis, etc., which would support the decision to continue operating the reactor until July.

Answer. It is correct that the C-reactor tank began to leak again in 1984 and was shut down for repairs in July 1985. The leak was first discovered in 1968, and it was patched. Operation of water reactor systems with known leakage within acceptable limits is allowed in licensed facilities with proper surveillance. The leak rate at C-ractor from 1984 to 1985 was well within the acceptable limits and, therefore, the decision to continue operation of the ractor was made. Although this decision predates the current leadership within the ASEH, the ASEH is presently compiling and reviewing the documents concerning the decision to continue operations and they will be sent to you at a later date.

Question 15. Describe the criteria on which the Office of Environment, Safety, and Health bases its recommendations/decisions to shutdown or reduce operations at DOE facilities. How did that critera factor into the recent decisions concerning the N-reactor and the Savannah River Plant reactors.

Answer. The criteria used to govern such recommendations/decisions are the Operations Safety Requirements (for nonreactor nuclear facilities) and Technical Safety Specifications (for nuclear reactors), which are derived from and take into account, among other considerations, risk/safety analysis data, technical factors, prior operating experience, and comparability to licensed commercial nuclear facilities. If the facility has a reasonable potential to operate in violation of this criteria, a recommendation is made to either reduce operations to the level necessary to be within the criteria, or shutdown operations until the facility can be made safe enough to come into conformance with the criteria.

In regard to the N Reactor, it was not shut down or reduced in operation. The N Reactor was put in a "standdown" mode of extended maintenance in order to expedite the completion of identified safety upgrades. This has allowed us to increase our confidence in understanding the issues and provides more assurance of continued safe operation.

In regard to the Savannah River reactors, the power levels were reduced to the point where we had acceptable technical confidence in the proper operation of the reactors' emergency core cooling systems. This judgment also took into account the low probability but possible high consequence of an accident that demanded the need for emergency core cooling water to prevent a reactor core meltdown.

Question 16. What is the current thinking in the department concerning outside independent overview? Who should do it, what elements of the programs should be reviewed, and how often should the reviews take place? Please provide any internal memorandums, studies, or other documents which would discuss the Department's views or plans for assessing the issue.

Answer. The position of the Department regarding outside independent overview is best documented in the testimony and prepared statement of the Under Secretary in his appearance before the Senate Committee on Government Affairs on June 17, 1987. A copy of the testimony is attached.[9] In his statement, the Under Secretary indicated the Department's preference for an advisory board whose responsibility would be to continually oversee the safety of the Department's nuclear facilities. Although the preference of the Department was stated by the Under Secretary, other options are continually being reviewed and considered. Until the final decision on a particular option is made, the details of the extent and timing on any reviews would be premature. Recent documentation associated with an internal review of safety oversight options is also attached.

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[9] See "Nuclear Protections and Safety Act of 1987," hearings, June 16, 17, 1987, Committee on Governmental Affairs.

United States Government Department of E

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memorandum

DATE: April 30, 1987

REPLY TO ATTN OF: EH-1

SUBJECT: ACTION: Strategy for Developing Measures to Further Strengthen ESH Oversight of DOE Facilities Including Options for Outside Oversight

TO: The Under Secretary

In December 1986, you asked this Office to review the policy issues related to oversight of the Department's facilities, and specifically, measures to further strengthen safety and environmental oversight, including increased "outside" oversight. This memorandum provides our initial thoughts and requests your approval of our intended scope of measures to be reviewed and a suggested process to develop specific recommendations.

BACKGROUND:

It has now been eighteen months since the Secretary announced his initiatives to strengthen the Department's environment, safety and health program. Significant strides have been made to achieve the objectives he outlined on September 18, 1985. Much of this progress stems from the strong and continued support that Secretary Herrington and top management have given to these efforts. Our DOE-wide baseline assessments, the Environmental Survey and the Technical Safety Appraisals, are at their midway points and have already heightened the Department's awareness of existing environmental and safety conditions and needed corrective measures. The strengthening of the EH policy and guidance functions has also facilitated compliance coordination with both line organizations and outside regulatory agencies, a key objective of the Secretary's initiatives. With the success of these initiatives, and the experience we have gained in the last year and a half with the oversight program, this is an appropriate juncture to consider how we might institutionalize the positive changes that have been made and add others that may be suggested by the lessons we have learned.

My memorandum to you of December 10, 1986, on the N Reactor, identified a number of policy questions and possible changes to the present system that I believed should receive additional consideration. These included measures to expand present programs and to obtain continued input from experts and/or organizations outside of DOE. The need to address these and related issues has been highlighted by the Roddis consultants and the National Academies of Sciences and Engineering (NAS/NAE) in our discussions with them. In addition, various options for outside oversight are being advanced in pending Congressional legislation.

While we have been reviewing these policy issues, for some months, including the question of outside oversight, we believe it appropriate to receive further guidance from you at this time as to whether our intended scope of actions is consistent with your earlier direction on this matter.

DISCUSSION:

While the Department's performance in the areas of environment and safety has been mixed, with many areas receiving inadequate attention in the past, the DOE safety record compares favorably with analogous industries, including NRC licensees. The record of worker lost time accident and fatalities is far better than national averages; radiation exposures of workers is lower in the DOE complex than in licensed facilities; and no accident of the order of TMI or Chernobyl has occurred.

Nevertheless, and while not understating the commitment that exists in the Department to assure effective safety performance, the additional reviews performed pursuant to the Secretary's initiatives this past year, and the outside reviews undertaken at his request, have demonstrated that real benefits can be gained by providing for such independent and external interaction. This tandem strategy--strengthened internal environmental and safety oversight and external expert advice--offers what may be the most credible and effective one for the Department to consider institutionalizing.

The following discussion is focussed on external oversight in the context of safety, since the outstanding jurisdictional issues of the Environmental Protection Agency's regulation of DOE operations and facilities have largely been resolved with the recent decision for joint regulation of all DOE waste streams under both the Atomic Energy Act and the Resource Conservation and Recovery Act. Thus, in the environmental area, we are virtually no longer "self-regulating."

Further, we have not addressed outside oversight in the area of occupational safety and health, because the Department's performance in this area has been, as a whole, significantly better than the national average. The DOE Orders already provide for the full implementation of OSHA criteria and standards. Additionally, the Department's program for investigations and oversight is, in fact, better than OSHA's at the Department of Labor. What should be considered, however, is some means to formalize access by the National Institute of Occupational Safety and Health (NIOSH) in the Department of Health and Human Services to the DOE workplace for hazard surveys and the collection of worker health data, and we propose to consider that further. Although we do not see any appreciable advantage to be gained by OSHA oversight, the Department should consider what opportunities exist for increased interaction between the two agencies.

Greater use of the Institute of Nuclear Power Operations (INPO) or an analog of that organization to promote improved communications and self-help among DOE contractors has been recommended by both the Roddis consultants and informally by the NAS. While we find merit in this proposal as a means to augment the DOE line program's capabilities in nuclear safety, we have not addressed this issue in this paper because it does not deal directly with the subject of the DOE safety oversight system.

As you announced in your December 12, 1986, press statement on the N Reactor, EH has been reviewing various options available to the Department in responding to the need for both outside nuclear safety oversight and enhanced nuclear safety program capabilities that organizations such as the Advisory Committee on Reactor Safety (ACRS) and INPO, or their counterparts, could provide. In this regard, I have personally met with the NAS/NAE committee that is reviewing the safety of DOE's Class A reactors. I have also met with certain members of the Roddis group, including Hal Lewis (a member of the ACRS) and Dennis Wilkensen, the President Emeritus of INPO. My staff and I have had both formal and informal discussions with several members of Congress and their staff on the subject, including several recent hearings which raised outside oversight as a main topic. My staff has also undertaken a series of meetings with INPO's senior management to explore expanded, mutual cooperation.

The range of options we are considering in the safety area is not new. It is my understanding these options have been assessed both inside and outside of the Department for some years. What has changed, however, are the circumstances under which the current debate is occurring. Problems uncovered at a number of DOE facilities (by our own reviews) are no longer being viewed in the context of a legacy of safety problems that are now being identified and corrected, but rather, as an indication of a current lack of effective checks and balances in the Department's system for assuring safety. A reoccurring theme outside of the Department is that no matter what independent safety organization exists within the DOE, nor how strong Secretary Herrington and his team's commitment is, the safety oversight provided in the future will not be independent enough to assure the public and Congress that the Department will put safety first.

While we have recognized such "perception" concerns, they have not been the driving force in our review. Rather, the scope of the recommendations for change, set forth below, arise from our own views as to what could appropriately contribute to an even more meaningful safety oversight of DOE facilities.

Structurally, the changes that we believe should be considered fall into three categories:

1. Outside nuclear safety oversight of DOE operations.

   There is much to suggest an appropriate, permanent group that would provide independent views to the Department regarding policy issues and operations related to nuclear facility safety. We would not want to permit the erosion of facility safety to the point where the Department's mission is jeopardized, or to the point where defense needs can only be met through operation of facilities which should be replaced, or to a point where worker and/or public safety may be exposed to unnecessary, even if not great, risks. Formation of a permanent, outside group that watches over the safety implications of the Department's overall nuclear programs and safety policies, and is not dependent on a particular, personal commitment of individuals such as Secretary Herrington, can provide an additional and constant check and balance. Additionally, the use of outside expert groups such as NIOSH, ACRS, and NAS, should be incorporated as an integral adjunct to the Department's environmental and safety oversight system, triggered when an appropriate need arises. Our own use of such groups this past year (e.g., the Roddis consultants and the NAS) suggests a permanent group for DOE and ad hoc use of existing groups, as appropriate, is the correct strategy.

Improvements to internal oversight of DOE operations.

The Secretary's initiative for Technical Safety Appraisals of contractor operations has been highly successful. These and other, continuing EH reviews are effective audit devices when used as a systematic means of assessing contractor and field office safety performance. However, the results of these appraisals show that at many of our facilities there is a need for better day-to-day safety surveillance and strengthened contractor capabilities to achieve full compliance, let alone excellence, in operations. We believe increased presence of our safety professionals at our contractors' operations is needed; more than is provided by "one shot" appraisals by either EH or the Operations Offices. Among the additional measures we would like to consider is the use of "resident" EH inspectors at major DOE field installations, much like the resident inspector program of the NRC.

Improvements to independent oversight of new construction projects.

In the commercial sector, NRC approval of power reactor designs is provided prior to construction and following extensive review of a utility's construction proposal; after construction, formal licensing for operation takes place. In DOE, early independent environmental and safety review of proposed facilities by my Office is currently accomplished solely through the National Environmental Policy Act (NEPA) process, with formal safety involvement (through review of Safety Analysis Reports) often not taking place until well after construction has begun. Under these circumstances, our reviews are likely to be hurried, or worse, too late to have significant influence on the design of the facility. We would like to consider a better system that would secure a timely, focussed assessment of the safety of new facilities while still in the design phase. Such an assessment could be provided by EH staff (assuming additional resources were available as needed) or by an outside group with the appropriate technical safety credentials.

Our experience in the past 1-1/2 years lead us to conclude that the scope of the options outlined above is appropriate for us to consider as we develop more specific recommendations for you and the Secretary. There is merit in considering by what means the safety oversight of DOE operations can be further improved, and effective solutions are available that do not require legislation. The ability of DOE to advance such initiatives in a proactive manner, however, may be hampered by events unless a concerted assessment of these issues can be performed in a timely fashion. To this end, I recommend the following:

RECOMMENDATION:

That EH lead a working group, including field and program representatives, that would identify appropriate options for improving oversight, consistent with the scope of the areas identified above. The results would be discussed with senior Department program and field managers, and the final recommendations presented to you in a subsequent memorandum from EH-1.

I would expect this group to be convened immediately upon your approval and that this effort and the coordination process would occur in an expeditious fashion, such that you could receive our final, specific recommendations as early as the beginning of June.

I recommend you approve both the above outlined process and the scope of the areas of improvement in safety oversight we would consider in furtherance of your earlier request.

Mary Walker

Mary L. Walker
Assistant Secretary
Environment, Safety and Health

APPROVED:
DISAPPROVED: ______________
DATE: 5-1-87

EH-35:Fitzgerald:kf:586-2407:4-30-87

— THIS PANEL SHOULD
BE THE FOCAL PT
FOR REVIEW & COMMENT
FOR PENDING LEGISL.
INCLUDE CONG. —

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United States Government **Department of En**

memorandum

DATE: May 4, 1987

REPLY TO ATTN OF: EH-1

SUBJECT: Request for Participation in Developing Measures to Further Strengthen ES&H Oversight Functions Including Outside Oversight

TO: Program Secretarial Officers
Operations Office Managers

This memorandum will provide you with a status of EH's review of the policy issues surrounding ES&H oversight of the Department's operations, and requests your participation in developing recommendations to further strengthen the safety oversight functions for the Department.

In furtherance of continuing the environmental and safety policies instituted by Secretary Herrington, we were asked last year to review the Department's safety and environmental oversight programs to consider further improvements, and to specifically consider the issue of permanent, outside oversight for the Department. This review has been proceeding within EH, and is now at the point where Department-wide involvement is appropriate. Further, several legislative proposals have been introduced which call for outside oversight of the Department's operations, and a Departmental position on these needs to be developed.

Copies of two of the pending bills are enclosed, S. 1085 introduced by Senator Glenn on April 23, 1987, and H.R. 2047, introduced by Representative Dicks on April 9, 1987. Both would establish a new, independent regulatory authority to oversee DOE nuclear safety. To assure that we are proceeding in our review of the oversight issues in a manner consistent with the Secretary's and Under Secretary's desires, we outlined our proposed strategy in the enclosed memorandum. Basically, EH recommended three broad classes of proposed change:

(1) the creation of a permanent, outside group that watches over the Department's overall nuclear safety programs and policies;

(2) the increased presence of EH safety professionals in the field; and

(3) an improved system for early safety assessments of new facilities.

We further recommended that EH lead a working group, including field and program representatives, that would identify options that should be considered by senior management, and that specific recommendations for change be developed by EH from this effort.

The Under Secretary has approved the EH proposal, including the scope of the changes to be considered. He has also asked that the working group we convene review the pending legislative proposals. The process calls for final specific recommendations from EH-1 concerning the oversight issues in late June - early July. It is anticipated that the working group will focus on an updated evaluation of options that reflects today's circumstances, and which will effectively carry forward the three classes of changes set forth above.

In addition, given the prospects for Congressional hearings on the related pending legislation in the near future, comments on the proposed legislation will be concurrently developed with this effort.

To meet needed schedules, I would like the working group to be reasonable in size, including representatives from DP, ER, NE and four of the field offices. We would like to hear from those field offices able to commit the necessary time of their representatives to this effort. Accordingly, we would like those program offices and the operations offices to nominate a senior representative who can participate in working group meetings during two weeks in the month of May. I have asked Grover Smithwick, my Principal Deputy, to chair the working group, and have asked him to hold the first meeting beginning May 11. Additional background materials will be provided to working group members this week.

I believe the steps outlined above will provide an effective means of obtaining early and effective action in an area of great importance to the Department. I appreciate your continued support and look forward to discussions with you on this action.

Mary Walker

Mary L. Walker
Assistant Secretary
Environment, Safety and Health

Enclosures

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United States Government **Department of Energy**

memorandum

DATE: June 9, 1987

REPLY TO ATTN OF: EH-35

SUBJECT: External Oversight Options

TO: S. R. Foley, DP-1
J. F. Decker, ER-1
A. D. Rossin, NE-1
DOE Operations Office Managers

Attached is a draft analysis of oversight options, as discussed in the Under Secretary's telephone conference call on June 1, 1987. It is being provided to assist you in preparing for discussions on this issue later in June or early July. This material supplements and summarizes more detailed background information which was provided to the DOE working group chaired by Grover Smithwick, my Principal Deputy, which has been examining nuclear safety oversight options.

If you have any questions, please contact either he or Joseph Fitzgerald, Acting Director, Office of Safety Policy.

Mary L. Walker
Assistant Secretary
Environment, Safety and Health

Attachment

6/9/87

Analysis of External Oversight Options

1.0 Introduction

On May 1, 1987, the Under Secretary approved a plan for developing measures to further strengthen ES&H oversight of DOE facilities including options for outside advice and oversight on nuclear safety. Pursuant to that plan, a working group was formed to review the various options for improving nuclear safety oversight of DOE operations. The working group consisted of representatives from DP, NE, ER, and five of the eight Operations Offices. This paper utilizes the input of the working group, and provides a summary analysis of the major options evaluated by the working group for providing external oversight.

2.0 Criteria for Consideration of External Oversight Options

The problems that have been identified at a number of DOE facilities are being viewed as an indication of a current lack of an effective system for assuring safety. Generally, the problems are perceived to be due to aging facilities that cannot meet current standards, inadequate nuclear safety policies and standards, and a safety oversight system that has inadequate checks and balances. These perceived problems have resulted in proposals to strengthen the DOE system, including greater use of independent experts who would evaluate the safety practices and policies of the Department. The scope of the options evaluated, while recognizing legislative proposals, have been considered based on their ability to contribute an even more meaningful and credible nuclear safety oversight system that, while retaining the most positive elements of the current system, will address identified weaknesses by strengthening institutional checks and balances through both external and internal means. Each of the options considered by the working group was evaluated against the following criteria:

- o Institutional assurance that DOE facilities meet accepted nuclear safety standards, with the goal achieving operational excellence,
- o Assurance of strict accountability by DOE and its contractors to compliance with safety requirements and necessary corrective actions,
- o Assurance that the system of internal and external checks and balances is complete and effective,
- o Assurance that the independence and strength of the Department's ES&H safety oversight function is institutionally guaranteed; preserving safety as an integral part of line management responsibility,
- o Assurance that the most cost-effective means to accomplish the objectives are implemented with minimum duplication of government effort, and
- o Preservation of the ability of the Department to effectively accomplish its national security and energy research missions.

The objective for DOE is to provide greater assurance that the construction and operation of the DOE nuclear facilities is being conducted at a high level of quality at least comparable to commercial standards. Therefore, in addition to the above criteria, each of the options were also compared from the standpoint of their ability to enhance the:

- Adequacy of ES&H policies and standards
- Indepth review of the design and construction of DOE facilities

- Operational oversight of DOE facilities
- Evaluation and application of lessons-learned from practices and events both internal and external to DOE

3.0 External Oversight Options

Several options have been considered for external oversight of the DOE environment, safety and health program. Essentially they can be categorized into three areas: (1) regulation by the NRC or new agency; (2) independent reviews and advice from the ACRS or new ACRS-like group; and (3) independent reviews (oversight only) by an outside group (e.g., NAS). The options that were considered are:

Regulation and Licensing by NRC

This option would provide NRC with the authority, mandated by legislation, to license new DOE facilities. NRC and agreement States would periodically review the design and inspect the operations of all DOE nuclear facilities. All new DOE nuclear facilities would need to comply with the licensing and regulation requirements of the NRC and agreement States. Legislation to mandate such an option was introduced by Representative Wyden (H.R. 783) on January 27, 1987.

NRC licensing would improve the independent overview and credibility with the public and provide continuing assurance of comparability with commercial standards and practices and the application of lessons-learned from events and practices of the commercial nuclear community.

The use of NRC to regulate the Department's environmental, safety and health program and to license new nuclear facilities would tend to force compliance of commercial standards to the Department's diverse nuclear facilities and reactors, which would provide comparability but would be, in most cases, impractical because of the mission and design of these facilities. Alternatively, NRC could undertake the effort to establish standards that are applicable to the Department's diverse nuclear facilities and reactors, which are tailored to the mission and design of such facilities; however, this would be redundant to the existing DOE Orders.

This option would also create the most potential for adverse national security impacts due to the time necessary to go through the current licensing process. Regulation would also contribute to a tendency to rely on NRC to determine safety adequacy and thus not preserve DOE's accountability for safety. Since both NRC and DOE utilize the same group of experts (i.e., DOE's contractor and laboratory organizations) for safety research and safety reviews, additional oversight by NRC would be duplicative and would pose a conflict of interest for most DOE laboratories. In addition, although NRC could review the design and construction of DOE facilities, continuous operational oversight of the many diverse DOE facilities would not be practical without significant increases in the NRC staff and budget and could divert their attention to their primary mission of regulating commercial nuclear power plants. The NRC staff would also have to expand their knowledge beyond licensed commercial facilities.

Regulation by a New Agency or Board

This option would provide for the establishment of a new regulatory agency or review board. The agency/board would issue policy on health and safety protection of the public and periodically review the design and operation of all DOE nuclear facilities to assure compliance. The agency/board would report directly to Congress. Legislation has been introduced in Congress by Senator Glenn (S.1085 dated April 23, 1987) and Representative Dicks (H.R. 2047 dated April 9, 1987) favoring an Independent Nuclear Safety Board and a Defense Nuclear Facilities Agency, respectively.

This option places ES&H oversight in a high level independent organization which would have more control and influence than an advisory type external oversight function. Although a regulatory body, the agency or board would be divorced from NRC and, therefore, more likely to maintain a commitment to DOE's unique operations and national security mission by either adopting the existing DOE Orders with modifications to make them more comparable to the licensed nuclear community or by providing exemption to licensed facility requirements when the design and/or mission of a DOE facility indicates safety enhancement is not significant or cost-effective.

An agency or board would duplicate or replace some of the capabilities of existing DOE oversight organizations and would contribute to a greater tendency to rely on a regulatory body to determine safety adequacy, as happened in the commercial sector prior to TMI. A new agency or board would also duplicate NRC capabilities and expand access to national security information. Review boards, such as the NTSB, have proven to provide effective evaluation and application of lessons-learned from events and practices and could provide DOE with a high level, external perspective with less resources than a regulatory agency. However, as currently proposed (S.1085), the review board functions have been narrowly defined.

A new agency/board could review the design and construction of DOE facilities; however, continuous operational oversight of the many diverse DOE facilities would not be practical without significant staff and budget resources. Staff resources would also have to be developed to provide sufficient knowledge of DOE operations and facilities; therefore, initially the new agency or board would be in a learning stage and not be as effective as some of the other options early on.

Utilize Existing MOU with NRC to Obtain Routine ACRS Reviews

In this option, the ACRS would be utilized to review Safety Analysis Reports for new projects and safety analyses for modifications to existing facilities. To assure that safety practices and standards remain current, biennial reviews by an ACRS subcommittee of programs at various sites and major facilities would be conducted. Reviews of special technical problems would also be provided as needed. The existing DOE/NRC Memorandum of Understanding (MOU) provides for DOE requests for ACRS reviews of the design of new and existing DOE facilities. However, legislation would probably still be desirable to ensure that the process is institutionalized, so that the ACRS role could not be reduced or eliminated as it has been under the current voluntary arrangement provided for in the Energy Reorganization Act of 1974. Legislation introduced by Senator Glenn (S.1085 dated April 23, 1987) provides for the expansion of the ACRS by five members to perform this mission in a similar manner. The ACRS role would be advisory.

Since the ACRS is an existing organization, their method of operation and protocol is familiar to most DOE organizations, and they have established credibility, at least for reactor safety, not only with DOE, but with the public and Congress.

The ACRS would provide a degree of comparability with the commercial sector, although there could be differences of opinion resulting from the significant differences between most DOE facilities and licensed facilities. Also, because of their familiarity with licensed facility standards and criteria, the ACRS could have a tendency to recommend compliance to commercial standards, which would promote comparability, but would be, in most cases, impractical because of the unique missions and diverse designs of DOE facilities. Since the ACRS would be in an advisory role, they would not establish new standards, criteria, or policy, but could recommend the Department to follow or agree to specific exemptions from selected requirements of applicable licensed facility policies, standards, and criteria.

The ACRS would perform indepth reviews of the design and construction of DOE nuclear facilities; however, continuous operational oversight of the many diverse DOE nuclear facilities would not be practical nor is it a part of their present charter. The use of the ACRS could enhance the application of lessons-learned from events and practices of the commercial licensed nuclear community to Departmental facilities.

Because the ACRS reports to the NRC, is funded by NRC, and has its agenda controlled by NRC, there is a potential for a conflict of interest in (1) establishing priorities associated with NRC vs. DOE problems/reviews, and (2) for most DOE laboratories since both DOE and NRC utilize the same group of experts (i.e., DOE's contractor and laboratory organizations).

The ACRS would also have to significantly increase its staff support and scope of technical capability beyond reactor safety, and there may be concern on the part of NRC and Congress that its primary mission of advising the NRC on commercial nuclear industry safety would be diluted or compromised.

The role of the NRC staff in the evaluation of Safety Analysis Reports prior to ACRS consideration also is an issue that would need to be resolved as part of this option. The NRC staff typically provides these evaluations to the ACRS, so NRC staff would also need to expand their areas of expertise beyond reactor safety. Alternatively, the DOE ES&H staff could perform this function, which would ensure more direct knowledge of DOE's unique facilities and preserve the internal ES&H oversight capability and function.

Establish a New ACRS-Type Organization

This option would establish a new ACRS-type organization to review the design of new and existing DOE nuclear facilities. The organization would review Safety Analysis Reports for new projects and safety analyses for modifications to existing facilities. In addition, periodic reviews by the ACRS-type organization of programs at various sites and major facilities could be conducted. Legislation would be required to assure that the process is institutionalized. The role of this organization would be advisory.

An ACRS-type organization for DOE would improve credibility with the public and Congress and provide a continuing outside technical perspective on nuclear safety programs. Conceptually, a new ACRS-type organization could be tailored to better support the varied functions and missions of DOE facilities, but it would take more time and resources to establish. Committee members could be selected to ensure more expertise in DOE-type operations than the NRC ACRS, so that its technical capability and judgments would better assure the safety of DOE facilities. Since the committee would be dedicated to DOE, oversight would be more responsive with no conflicting demands on the committee time that would exist if the NRC ACRS was utilized. The committee activities could also be prioritized so that key generic and technical safety issues are addressed, including routine evaluation of existing and proposed DOE policies and standards for adequacy and comparability with NRC rules. The existing DOE ES&H organization would continue to fulfill its oversight role on a routine basis and could provide safety evaluation, investigation, and appraisal reports and support to the committee for their advice and recommendations on design, construction, or operational practices and issues. Some continued coordination with NRC would still be beneficial in order to assure comparability on similar nuclear safety issues.

Independent Review (Oversight) by the National Academy of Sciences (NAS) or Other Independent Scientific Body

This option provides for the NAS to be utilized to provide an independent overview of DOE activities on an as needed basis. The NAS would be requested by DOE to review the design and/or operation of major nuclear facilities, both new and existing, to assure compliance with applicable environmental, safety and health standards. In legislation proposed by Senator Glenn (S.1085 dated April 23,1987), the NAS would also review and determine difference (if any) between NRC licensed facility regulations and the DOE Orders. No legislation would be required to provide for NAS reviews, and the NAS role would be advisory.

NAS, like the ACRS, has established credibility with the public and Congress and no legislation would be required. NAS has limited resources to provide for a continuing overview function. NAS or other scientific bodies could obtain the expertise needed to review policies and standards and to conduct reviews of Safety Analysis Reports for new and existing major DOE facilities, but could not reasonably conduct operational oversight of all DOE facilities. If NAS was provided significant additional funds by the Government for continued oversight, their existing mission and independence could be jeopardized, as well as the public's perception thereof. Periodic oversight by NAS may provide sufficient assurance that the DOE internal oversight program is effective and a sufficient incentive to maintain it.

Independent Review (Oversight) by a New Independent Inspector General for Nuclear Programs

This option is proposed in the Johnston-McClure bill (S.748 dated May 13, 1987) to amend the Price Anderson Act. The bill provides for the establishment of an independent Inspector General (IG) for Nuclear Programs who would report directly to the Secretary and Congress. The option is a compromise position between external and internal oversight. The functions of the IG would be to provide management oversight of the DOE ES&H program, conduct auditing and investigation activities, recommend policies with respect to ES&H matters and rule violations, and inform the Secretary and Congress of ES&H problems or deficiencies including recommended corrective actions.

An independent IG would place the oversight of the management of ES&H programs in a high level management organization with more influence than presently exists within DOE. The IG role would also have more control than an advisory group. The authority of IG officials improves public credibility. The functions of a new IG could be tailored to support the varied missions and functions of DOE facilities and would not undermine the existing responsibilities of the line organization under the present system of management. The Inspector General could review the adequacy of ES&H policies and standards, but would not undertake indepth, technical reviews of the detailed design, construction, and operation of DOE facilities as currently proposed. Initially, the IG organization would lack sufficient technical capability and expertise to be effective; however, in the long term, it could provide the necessary stimulus to maintain a strong internal ES&H program within the Department.

Question 17. Is it DOE's policy that the production reactors be comparably safe to the commercial nuclear reactors? If so, what systems are in place to demonstrate whether or not the level of safety is comparable? What do these systems show?

Answer. The DOE Orders contain policy statements that require that all DOE nuclear facilities and reactors are to be sited, designed, constructed, modified, operated, maintained, and decommissioned in a manner that gives adequate protection for health and safety and will be in accordance with uniform standards, guides, and codes which are consistent with those applied to comparable licensed facilities.

For licensed reactors, the General Design Criteria specified in 10 CFR 50, Appendix A, are applied to assure consistent application of design requirements. The same General Design Criteria are applied to all new DOE reactors.

Although the policy of comparability has been in place within the Department since its conception, the implementation of these requirements in the past, particularly in regard to documentation of the application of licensed nuclear facility requirements to DOE operations, has been lacking. In March of this year, the ASEH took the initiative to determine and document the applicability of many new licensed nuclear facility requirements on DOE operations. A copy of the March 20, 1987 memorandum implementing this initiative is attached. Design Reviews on the N-Reactor have been performed in the last year by the ASEH. These reviews describe differences between the reactors and NRC's General Design Criteria, as well as other departures from current NRC requirements. Recommendations were developed to bring the reactors into closer conformance to NRC requirements (attached.) The Department is considering the institution of a program similar to the NRC's Systematic Evaluation Program, as a mechanism which, in concert with ongoing probabilistic risk assessments and safety analyses, could help demonstrate that there is an acceptable level of safety at the production reactors.

Question 18. What are the department's plans for meeting production needs over the next 5 years, 10 years, and 20 years? If the plans include a new production reactor, what reactors would it replace, how much would it cost, and when would it come on line? If no new reactor is planned, what will be the cost per year over the next 10 years of continuing to operate and maintain the existing reactors at a safety level comparable to the commercial nuclear reactors? If your plans are not finalized, please provide any memorandums, studies, or other documents which discuss any preliminary information or plans for assessing these issues.

Answer. To meet requirements of the Nuclear Weapons Stockpile Memorandum, which covers an 11-year period, highly enriched uranium, tritium and weapon-grade plutonium will be reclaimed by the Department of Energy (DOE) from retired Department of Defense weapons, reprocessed, and used to build new weapons. Demand which cannot be supplied from retirements and from plutonium already available within the DOE weapons program, will be met by new production in the three Savannah River Plant production reactors, the Richland N Reactor blending of DOE-owned nonweapon-grade plutonium to weapon-grade specifications and processing of scrap generated in the fabrication process. We plan to continue to operate the DOE reactors as needed to meet stockpile requirements.

The plans under consideration by the DOE in the 10 to 20 year time frame encompass initiating work on a new production reactor with a well established technology that will provide an assured supply of tritium by the year 2000. Depending on the concept and site selected, the new production reactor would cost between $3 billion and $5 billion. Design and construction of this reactor will take 10–12 years. Once operational, this reactor could replace one of the currently operating reactors.

Question 19. What was the department's basis for the decision on March 20, 1987, to further reduce power of the Savannah River Plant reactors?

Answer. The events leading to that decision are generally set forth in the letter from the Under Secretary to Senator Glenn of March 23, 1987. On March 20, 1987, the Under Secretary imposed a "no bulk boiling of emergency core cooling water upon LOCA" criterion. When this conservative criterion is met by reducing the operating power levels, there is assurance that under LOCA conditions, the Emergency Core Cooling System will prevent core damage.

The situation of concern is that with present plant and fuel assembly design, some of the fuel assemblies would receive relatively little cooling water following a loss-of-coolant accident. As a result, boiling of whatever water was present in the fuel assembly would occur, which would tend to cause a rapid heatup of fuel assemblies. At this point, the consequences are hard to quantify; the physical processes involved are very complex and are difficult to model for computer-type analyses. DuPont, the operating contractor, and DOE have recognized these concerns, and an action plan to provide the necessary experimental and analytical program is being prepared to provide an improved basis for establishing power limits. EH is reviewing this action plan. After it has been established, EH will independently review its implementation for adequacy in satisfying safety requirements.

Question 20. Please provide the details of the decision to shutdown the reactor at Oak Ridge, including any memorandums, reports, or other documents surrounding that decision.

Answer. Oak Ridge National Laboratory (ORNL) operates five reactors for DOE. These reactors are the: High Flux Isotope Reactor (HFIR), Oak Ridge Research Reactor (ORR), Tower Shielding Reactor (TSR), Bulk Shielding Reactor (BSR), and Health Physics Research Reactor (HPRR).

In mid-1986, as the result of a post-Chernobyl Ad Hoc Reactor Review and Audit Committee established by Martin Marietta Energy Systems (MMES), it was discovered that the pressure vessel embrittlement was outside the original limits established for safe operation of the HFIR reactor. On November 14, 1986, MMES reported to DOE that the HFIR, which has been shut down for normal refueling, would remain down pending resolution of the embrittlement problem. Subsequently, ORNL ordered the HFIR to remain shut down until the embrittlement problem is resolved. This was accomplished by the issuance of an Unusual Occurrence Report which is attached.

As a result of this problem and the circumstances surrounding it, many reviews of the HFIR and Martin Marietta management were made. As a result of the Management Review of Martin Marietta Energy Systems, on March 27, 1987, the Manager of OR announced that the four other ORNL operating reactors (ORR, BSR, HPRR, and TSR) had also been placed in safe shutdown. The reasons for this decision were deficiencies in ORNL management and administrative controls related to reactor operations. Although there was no single concern that suggested an immediate safety issue, these types of concerns were indicative of a management problem which, if not corrected immediately, could possibly lead to a safety issue. The letter confirming a shutdown of the four reactors is also attached.

OR A-121

MARTIN MARIETTA

MARTIN MARIETTA ENERGY SYSTEMS, INC.

MARTIN MARIETTA ENERGY SYSTEMS, INC.
OAK RIDGE NATIONAL LABORATORY
UNUSUAL OCCURRENCE REPORT

Page 1 of 4

1. Report No. ORNL-86-18-HFIR-86-3
2. Report Date
   Initial December 2, 1986
   Interim ____
   Final ____
   Recd 12/22/86 Direct

3. Division or Project

Operations Division

4. Facility, System, and/or Equipment

High Flux Isotope Reactor (HFIR)

5. Date of Unusual Occurrence: November 5, 1986

6. Time of Unusual Occurrence: --

7. Unusual Occurrence Subject

Unexpected increase in nil ductility transition (NDT) temperature of reactor pressure vessel surveillance specimens.

8. Apparent Cause: Design ____ Material x Personnel ____ Procedure ____
   Other ____, Explain in Item 14

9. Description of Unusual Occurrence

Pressure vessel surveillance specimens removed from the reactor in October 1983, but not analyzed until recently, indicated an unexpected increase in NDT. Additional specimens removed in November 1986 confirmed these results and indicated that there is a shift in the NDT temperature of the reactor pressure vessel (see pages 3 and 4 for additional details).

10. Operating Conditions of the Facility at Time of Unusual Occurrence (if applicable)

The reactor normally operates at 100 MW at 750 psig with coolant inlet and outlet temperatures of 120°F and 160°F, respectively. The vessel temperature is approximately 120°F.

11. Immediate Evaluation

There is a potential problem with loss of ductility at low temperature for the reactor pressure vessel. The reactor safety system would shut the reactor down on a loss of primary system pressure, and the low energy content of the primary system does not present a problem such as would be experienced in a high temperature pressurized system such as a pressurized water reactor. However, the reactor will remain shutdown until all aspects of the problem can be fully evaluated.

UNUSUAL OCCURRENCE REPORT

Page 2 of 4

Report No. ORNL-86-18-HFIR-86-3

Report Date December 2, 1986

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12. Immediate and/or Temporary Corrective Action Taken and Results

The reactor will remain shutdown until an investigation into the problem is complete.

---

13. Is Further Evaluation and/or Corrective Action Necessary? Yes x No ____

If Yes: Before Further Operation Yes

By Whom? ORNL Special Review Committee

When ________________

NOTE: A DOE/ORO Type B investigation and a Special DOE Hq. Investigation are part of a review effort by DOE.

---

14. Final Evaluation and/or Corrective Action

To be determined.

Taken ________ Recommended ________ To be supplied x

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15. Programmatic Impact

The reactor was shut down as scheduled on 11/14/86. Extended shutdown of the reactor will delay the various research and isotope production programs.

---

16. Impact Upon National Codes and Standards, Including RDT Standards

To be determined.

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17. Similar Unusual Occurrence Reports [indicate report no.(s)]

None.

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18. Suggested Laboratory-wide Application of Corrective Action Taken for this Unusual Occurrence

To be determined.

---

19. Signatures:

Originator B L Corbett — B. L. Corbett, Facility Supervisor Date 12/2/86

Approved by R V McCord — R. V. McCord, Section Head Date 12/2/86

Approved by J H Swanks — J. H. Swanks, Division Director Date 12/2/86

Approved by F R Mynatt — Associate Director, Nuclear & Engineering Technologies Date 12/2/86

MARTIN MARIETTA ENERGY SYSTEMS, INC.

OAK RIDGE NATIONAL LABORATORY

UNUSUAL OCCURRENCE REPORT
CONTINUATION SHEET

Page 3 of 4
Report No.
ORNL-86-18-HFIR-86-3
Report Date
December 2, 1986

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9. Description of Unusual Occurrence (continued)

The original design of the reactor vessel was based on providing at least 20 full-power years of service at 100 megawatts (MW). There had been 17.2 full-power years accumulated at the last shutdown on November 14, 1986. The design of the vessel was based on experiencing no significant radiation damage to the shell of the vessel, which was made from carbon steel (ASTM A-212, Grade B) clad with stainless steel on both sides. The nozzles of the beam tubes see a greater fluence than the shell due to the decreased shielding offered by the beam ports. Thus, the nozzles were made from ASTM A-350, Grade LF3 and ASTM A-105, Grade II, which had greater initial fracture toughness.

To monitor the radiation damage of the reactor vessel during its operating life, a surveillance program based on the analyses of vessel specimens was initiated in 1966. This surveillance program was described in a report entitled "HFIR Pressure Vessel and Structural Components Material Surveillance Program" (ORNL/TM-1372). Changes to the schedule for surveillance testing were made based on test data obtained early in the vessel life. Test data from specimens removed in 1983 were not promptly obtained and analyzed. A reliance on the original design, that is, that the vessel would undergo no significant radiation damage during its design life, resulted in the acceptance of extensive delays in having surveillance tests completed and analyzed. In November 1986, tests results and analyses of surveillance specimens removed in 1983 showed a significant amount of radiation embrittlement of the reactor pressure vessel materials. This embrittlement, which is typically measured by the nil ductility transition (NDT) temperature, defines the parameters for the safe pressure-temperature operating limitations for the vessel.

The apparent shift in the NDT temperature, as indicated by the specimens removed in 1983, resulted in additional surveillance specimens being removed from the vessel on November 15, 1986. On November 14, the decision was made by ORNL not to operate the reactor until the Laboratory is convinced that all potential safety issues have been satisfactorily resolved. The following table is a summary of the recent findings of the surveillance program.

NOTE: Please use this form when there is insufficient space for providing complete information. Indicate the appropriate "Page No.," "Report No.," and "Report Date." When entering information on this form use the appropriate information item number(s) and title(s) as indicated on Report Form.

MARTIN MARIETTA ENERGY SYSTEMS, INC.

OAK RIDGE NATIONAL LABORATORY

UNUSUAL OCCURRENCE REPORT CONTINUATION SHEET

Page 4 of 4

Report No. ORNL-86-18-HFIR-86-3

Report Date December 2, 1986

9. Description of Unusual Occurrence (continued)

Vessel location	Material	Unirradiated NDT (°F)	1983 NDT + 60°F	1986 NDT + 60°F
HB-1, HB-4	ASTM A 105 II	-65	45	--
HB-2	ASTM A 350 LF3	-115	55	75
HB-3	ASTM A 350 LF3	-85	85	100
Shell (IC3)	ASTM A 212 B	0	80	--
HB-1A, HB-4A	ASTM A 212 B	0	115	135

The present pressure-temperature limits contained in the HFIR Technical Specifications (ORNL/TM-5711/R2) are based on Pellini's concept that the operating limits for the vessel should be 60°F above NDT. A more detailed analysis based on linear elastic fracture mechanics will be used to evaluate the reactor vessel's capability for further operation and any associated operational restrictions.

NOTE: Please use this form when there is insufficient space for providing complete information. Indicate the appropriate "Page No.," "Report No.," and "Report Date." When entering information on this form use the appropriate information item number(s) and title(s) as indicated on Report Form.

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Department of Energy
Oak Ridge Operations
P. O. Box E
Oak Ridge, Tennessee 37831

March 27, 1987

Mr. Kenneth Jarmolow
President
Martin Marietta Energy Systems, Inc.
P. O. Box Y
Oak Ridge, TN 37831

Dear Ken,

SHUTDOWN OF THE OAK RIDGE NATIONAL LABORATORY REACTORS

This confirms our direction on March 26, 1987 for an orderly shutdown of all Oak Ridge National Laboratory nuclear research reactors.

In general, the basis for the shutdown order was accumulation of input from the DOE Headquarters Reactor Management Review Committee and earlier reports indicating management oversight inadequacies for the Oak Ridge National Laboratory reactor operations.

As was discussed with your staff on March 27, we request early guidance from Martin Marietta Energy Systems, Inc., regarding the scope and schedule for those actions you would propose to remedy deficiencies and provide for assured safe operation of the four reactors shut down on March 26.

Sincerely,

Joe La Grone

Joe La Grone
Manager

U.S. DEPARTMENT OF ENERGY
P.O. BOX "E"
OAK RIDGE, TN 37831

DOENEWS:

FOR IMMEDIATE RELEASE
March 27, 1987

FOUR ORNL REACTORS ORDERED SHUT DOWN

OAK RIDGE, TN -- The Department of Energy's (DOE) Oak Ridge Operations has ordered the shut down of all nuclear research reactors at DOE's Oak Ridge National Laboratory (ORNL) because of concerns over ORNL management and oversight of reactor operations.

Joe La Grone, Manager of Oak Ridge Operations, yesterday instructed officials of Martin Marietta Energy Systems, Inc., which operates ORNL for DOE, to place four reactors in safe shutdown. The Oak Ridge Research Reactor, the Bulk Shielding Reactor, the Health Physics Research Reactor, and the Tower Shielding Facility were shut down by late afternoon.

The decision to shut down the reactors followed a briefing of DOE officials by members of a DOE Headquarters committee currently reviewing ORNL reactor operations at the request of La Grone and as part of an overall examination of DOE reactor operations by DOE's Assistant Secretary for Environment, Safety, and Health.

"I have taken this action," La Grone said, "because of cumulative concerns expressed by the Headquarters committee and concerns previously outlined by our own investigation which indicated deficiencies in ORNL management and administrative controls related to reactor operations."

"While there is no single concern expressed which suggests an immediate safety issue," La Grone said, "taken together these concerns are indicative of a management problem which, if not corrected immediately, could possibly lead to a safety issue."

"Before these reactors can be restarted, Martin Marietta officials must demonstrate to DOE that these management and oversight problems have been properly addressed and corrective action taken," La Grone said.

The Headquarters committee is one of nine committees reviewing previously announced radiation embrittlement problems with another ORNL research reactor--the High Flux Isotope Reactor--which has been shut down since November of 1986.

The 12-man Headquarters committee which briefed ORO officials on Thursday is conducting, at the request of La Grone in November of 1986, an independent management and design assessment of all safety elements associated with the HFIR and the Oak Ridge Research Reactor.

DOE's Assistant Secretary for Environment, Safety, and Health had scheduled a technical safety appraisal of HFIR and the ORR in 1988, and, in addition to the current design and management assessment now under way, has rescheduled the technical safety appraisal for a period of approximately three months after the resumption of reactor operations.

-DOE-

News Media Contact: Jim Alexander, (615) 576-0885
S-87-014

Question 21. In view of recent events, have any changes been made to insure that environmental, safety and health concerns at the DOE facilities are addressed promptly?

Answer. As the attached summary sheet on the status of major DOE nuclear facility safety actions demonstrates, the Department's response to identified safety concerns has been prompt, decisive, and conservative in kind. On the last point, DOE has not hesitated to suspend operations at a facility where there was evidence that the level of safety assurance was inadequate or not firmly founded on acceptable analysis or standards. For example: DOE has placed in standdown conditions of various duration five reactors at Oak Ridge (High Flux Isotope Reactor, Oak Ridge Research Reactor, Tower Shielding Reactor, Bulk Shielding Reactor, and the Health Physic Research Reactor), two nuclear facilities at Hanford (PUREX and the Plutonium Finishing Plant), and one reactor at Savannah River (C-Reactor). In addition, power levels of remaining production reactors at Savannah River have been reduced pending resolution of the emergency core cooling system concerns.

APPENDIX 1

DOE Response to Nuclear Facility Safety Findings:

N Reactor. Immediately following the Chernobyl accident, Secretary Herrington requested that my Office address potential implications to N Reactor through the acceleration of the Technical Safety Appraisal already planned for that reactor, and special reviews of the reactor's overall design, confinement system, and graphite growth. He also appointed the Roddis group to evaluate these issues and commissioned a special, longer term review, by the National Academy of Sciences. The N Reactor is not like Chernobyl. It has a record of more than 20 years of accident free operation. Many improvements have been made to the reactor since it began operation. However, the reviews revealed a number of areas in which improvement needed to be made. Some reviewers concluded that the departures from requirements for licensed reactors were of such a nature that the reactor should be shut down absent a compelling need for the facility to meet defense production requirements.

After the Department reviewed all the comments received, an aggressive course of correction was developed and programs are now underway to make further improvements to the plant and to the operations. The National Academy of Sciences has been requested to review the recommended approach towards hydrogen mitigation, and may offer additional recommendations when it releases its interim report on the N Reactor and Savannah River production reactors.

Savannah River Production Reactors. The Savannah River reactors have also been intensively reviewed since Chernobyl. There have been reviews of the fire protection systems, quality assurance programs, a Design Review, a Technical Safety Appraisal, reviews by GAO and by the National Academy of Sciences. The Savannah River Operations Office and the contractor, DuPont, has prepared an integrated response on how the contractor will implement the recommendations made by my Office. We are now reviewing that response.

The report of the NAS review has not yet been completed, but we expect that many of the concerns identified by earlier reviews will also be raised by the NAS, and new issues will probably surface that need to be acted on. The NAS has advised the Department of the NAS concerns about the emergency core cooling system for the Savannah River reactors.

As with licensed reactors, the Savannah River reactors rely on special systems to keep the core cool in the event of a failure in the routine cooling systems. Questions regarding the adequacy of these emergency core cooling systems (ECCS) finally led DuPont to conclude that safety margins were not as great as they should have been. In order to assure adequate cooling capacity, reactor power levels were reduced. The National Academy of Sciences, during the course of their review of the safety of DOE's Class "A" production and research reactors, raised substantial additional concerns that resulted in the Department taking immediate action to further reduce the power level to assure that the safety systems would function as intended, even under very unlikely accident scenarios. A special EH led team of experts has since reviewed the methodology used by Savannah River in meeting the imposed power criterion and found it to be acceptable. Actions are underway to develop the necessary technical data and to make needed hardware changes. No increase in power will be undertaken until such time that it can be convincingly demonstrated that emergency core cooling systems will work as intended under the full range of design basis accident conditions.

High Flux Isotope Reactor (HFIR). The operating safety limits for HFIR were approved by the Atomic Energy Commission in 1965 and included a surveillance program to evaluate the extent of radiation-induced embrittlement over the life of the reactor. HFIR was shut down in November 1986 following a determination by the Oak Ridge Operations Office (ORO) and a review by my Office concluding that the surveillance program had not been performed adequately and the technical basis supporting a key operating limit was no longer valid. This unprecedented action—shutting down a facility due to non-compliance with technical specifications and surveillance requirements—stems directly from the Secretary's initiatives in oversight and his expectation that line management exercise their prime responsibility for ES&H in a positive manner. A subsequent investigation by ORO identified a broad range of needed actions ranging from improvements to the surveillance program to better oversight by DOE and the contractor. Until all concerns surrounding the management of safety assurance at HFIR, all safety concerns raised during the course of our subsequent investigations, and the specific issue of pressure vessel embrittlement are resolved, HFIR will not be permitted to restart. We anticipate a program commitment to resolve the management issues by next month with an analysis of the embrittlement issues within several months.

Oak Ridge Research Reactors. The issues surrounding the HFIR incident raised concerns that similar problems might exist at other facilities. My Office conducted an independent review of the safety management, quality assurance, and safety oversight program at the Oak Ridge National Laboratory. This review confirmed the existence of deficiencies in the contractor and DOE oversight and safety management of remaining reactors at Oak Ridge. In response, the Manager of the Oak Ridge Operations Office ordered, as a precaution, the suspension of all operations at the other Oak Ridge reactors (Oak Ridge Research Reactor, Bulk Shielding Reactor, Health Physics Reactor, and the Tower Shielding Facility). Steps are now being taken by my Office, the program offices, Oak Ridge Operations Office, and the contractor, to strengthen the oversight system and reverse this situation. These reactors will not resume operation until institutional changes have been made and programs are in place to assure full compliance with DOE requirements and full cognizance by all levels of management of safety oversight responsibilities.

PUREX/Plutonium Finishing Plant. Acting on concerns surrounding violations of procedures, particularly those for criticality and quality assurance, the Department's Richland Operations Office (RL) Manager suspended operations at the PUREX plutonium extraction plant and the Plutonium Finishing Plant (PFP) in Octover 1986. To resolve the root causes of the observed problems, the contractor was directed to undertake a number of activities, including retraining of plant operators, improved management commitment and attention to enforcing procedures, and strengthened safety oversight. To assure that all actions were complete and satisfactory, the Operations Office performed a Readiness Review of all pertinent aspects of the safety programs at PUREX and PFP. My Office independently reviewed the results of this review and other actions undertaken by the contractor prior to startup of PUREX in March 1987. During the course of the Department's review of the seismic qualification of PFP, it was evident that the facility could be vulnerable to collapse in the event of a strong earthquake, and that an adequate safety analysis review had not been performed to assure that worker and public safety risks had been properly mitigated. Additional analyses of the plant and now being conducted and until their results confirm an acceptable margin of safety, DOE has chosen to keep portions of PFP shut down, except for recycling of a small quantity of existing plutonium scrap that needs to be processed for safety reasons.

Exemplary Operations Exist

The Fast Flux Test Reactor (FFTF) at Hanford, the Pantex weapons fabrication plant in Texas; and the TA-55 plutonium facility at Los Alamos, New Mexico have all been reviewed as part of the TSA program and found to be good models of the commitment to safety that we want to see in all of our operations. These relatively new facilities have both undergone intensive, independent safety reviews before operations commenced. The TSA teams found these operations are based on a strong commitment to safety, and deficiencies found in our appraisals were limited to largely procedural items. Other recently constructed DOE nuclear facilities, as well as those under construction, have been designed and constructed during the era of strict, and very prescriptive safety regulation. They meet not only licensed requirements, but represent safety models from which the NRC and the industry have drawn safety standards and experiences.

Question 22. What are the objectives, scope and timeframe of the Inspector General review at Savannah River Plant?

Answer. The Inspector General's review encompassed circumstances surrounding the National Academy of Science's inquiry into safety issues at the Savannah River Plant. The review is substantially complete and a report is expected to be issued to the Department soon.

As this is still an open investigation, if the Committee would like more information they may contact the Inspector General's office.

Question 23. What mechanisms are in place to assure that the information that your office is receiving from Savannah River Plant and other sites is sufficiently detailed to make good decisions? Are the safety overview staffs sufficiently independent to provide unbiased information? Is your office satisfied with the information it receives in terms of details and timeliness?

Answer. The ASEH is independent and routinely provides the Under Secretary and Secretary information representing an advocacy position on environment, safety and health matters. As with any organization, the recommendations and opinions of the ASEH rests on information made available to that group.

The Department of Energy has an order specifying routine reporting requirements that relate to environment, safety and health. This information, together with environmental impact statements and safety analysis reports should provide a fully adequate basis for informed decision-making. Unfortunately, there are occasional instances in which information has not been provided in a timely basis, or has not been identified as to its proper safety significance. In view of concerns in this area, reviews of our reporting system have been conducted and steps to improve that system are underway.

LOUIS H. RODDIS, JR., P.E., C. ENG.
CONSULTING ENGINEER

October 3, 1986.

CHARLESTON, SOUTH CAROLINA 29401

The Honorable John L. Herrington, Secretary
U.S. Department of Energy.
1000 Independence Avenue, S.W.,
Washington, D.C., 20585.

Dear Mr. Secretary:

As one of the six independent consultants you asked to report on the impact of the Chernobyl-4 disaster on the operations at the "N" reactor at Hanford, WA. I submit the following report.

SUMMARY:

1. The Advisory Committee on Reactor Safeguards in 1966 identified the basic hazards of the "N" reactor as follows:

> " The Committee again points out that radiological consequences in the unlikely event of a severe reactor accident at the N-Reactor during 4000 MW(t) operation would exceed the dose guidelines now used for licensed power reactors."

I believe this situation is unchanged today.

Therefore I recommend that the Department shut down the "N" reactor unless a positive judgement is made that the requirements for defense material warrants accepting public hazards exceeding those of commercial reactors.

2. If continued operation for the next several years is considered to warrant acceptance of these hazards, then a short term Action plan should be provided and executed based on the various sources of recommendations identified in the "Recommendations" section below. Briefly these include the 68 recommendations of the Departmental review teams that have just reported to you and some additional steps, especially those aimed at reducing the potential for a hydrogen explosion.

With these changes operation at the present power levels and core loadings can continue until 1990-1991 without risks increasing much over those now existing.

3. If continued production of Defense materials is required long term, replace the "N" reactor by a less unique design, with provision for accident mitigation similar to commercial reactors. This will be a challenging task, but is not a new idea. It was studied extensively in the 1982 time frame, but never executed, apparently for economy reasons.

LOUIS H. RODDIS, JR., P.E., C. ENG.
CONSULTING ENGINEER

SCOPE OF REPORT:

As one of six individual consultants asked to make recommendations on the "N" reactor in the light of the Chernobyl-4 accident this report is submitted. Appendix 1 contains the charge letter and my qualifications. The other appendices include a bibliography and the list of joint briefings and special meetings. The discussion, conclusions and recommendations below are based on the material and meetings listed therein and on my experiences in the nuclear power area since 1946. I have also benefited from discussions with the other five consultants; Dr. M. C. Leverett, Prof. H. W. Lewis, Prof. T.H. Pigford, Dr. G.F. Tape, and Mr. E.P. Wilkinson, but this report is entirely on my own responsibility.

I wish to thank Ms. Marilyn S. Smith, Special Assistant to the Director of Energy Research for her material assistance in acting as Departmental contact and Secretary to this group of Expert Consultants of which I have been the Administrative Chairman. Also to Mr. John R. Ireland and Dr. Glen Graves of the Los Alamos National Laboratory for their assistance as Technical Staff for our group. Without the assistance of these three individuals our task would have been much more difficult.

I would like also to thank the many members of the Department of Energy staff, and of members of their contractor's staffs, who prepared information and answered our many questions. Where information was available it was fully and factually made available. Several on-going studies were instituted to study specific additional matters which we identified.

LESSONS LEARNED:

From the two major power reactor core melt accidents of the past decade, Three Mile Island-2 and Chernobyl-4, there are several lessons to be drawn. They confirm the results of over a score of lesser core melt incidents.

1. The unexpected event can occur, often very quickly from either design or operator error, or both.

2. Gross core melting can occur with release of radioactivity from the system.

3. With proper design some amount of hydrogen reaction can be contained or prevented, thus reducing the release of radioactive products into the surroundings and mitigating the major effects of the accident.

ACCIDENT DESIGN.

World standards for accident design usually provide for a "most credible accident" which the reactor is designed to contain without release of radioactive products.

For the U.S. industrial power reactors, for the USSR power reactors, and for the "N" reactor this is basically to contain the mechanical energy of the coolant pressure and state change energy released by a double ended break in the largest pressure piping.

In addition the U.S. requires for commercial power reactors (10CFR50 Appendix K) that a non-mechanistic hypothetical accident which releases 50% of the fission products into the reactor building not release radioactive products to the surroundings to an unacceptable amount.

Such a criteria is not included in the USSR RBMK type reactor accident design standards. At Chernobyl a major release of radioactivity into the steam occurred almost instantanously with the multiple tube rupture which broke open the reactor vault by steam pressure, followed by hydrogen evolution and probable explosion.

Likewise the "N" reactor design is such that an instantaneous postulated radioactivity release accident cannot be handled during the first pressure venting phase of the accident. The "N" reactor design was premised on the assumption that this radioactivity release will not occur until after the first overpressure surge has been relieved by venting after several minutes. This assumption is fundamental to the confinement design of "N" reactor.

SIMILAR ACCIDENT.

The Chernobly-4 accident had three basic causes.

a. An incredible series of operating errors.
b. A basic design (positive void coefficient) which made the operation and control especially tender.
c. An accident mitigation system which did not provide containment if more than one tube rupture occurred simultaneously.

While no design can eliminate all operating errors the training and procedures at "N" reactor appear to be strong enough to reduce the possibility of gross maloperation.

Because of the negative void coefficient with the present loading and with the strong reactivity controls on the "N" reactor I consider it impossible for an accident exactly like the one that occurred at Chernobyl-4 to occur with the "N" reactor.

On the other hand a major accident not now covered in the "N" Reactor Upgraded Safety Analysis Report (NUSAR) cannot be ruled out. Such an event including multiple tube ruptures and the evolution of large amounts of hydrogen has not been thoroughly evaluated, in my opinion, in the NUSAR.

Except for the neutronics it does not appear likely that the graphite will contribute to the early stages of an accident, though it may enter chemically if a prolonged high temperature event is precipated by metal-water or other initiating events.

I have no doubt that the "N" reactor is of a safer design than Chernobyl-4, and is currently being competently operated. I do not believe that any experiment with the operating "N" reactor would be performed without very rigid controls and supervision.

Because of the physically large area around the "N" reactor the close in effects on large bodies of population that occurred at Pritipat would not occur. The emergency plan should however be better integrated with the adjoining State governments as recommended in the 8/5/86 GAO report.

PUBLIC PERCEPTIONS OF DOE RESPONSIBILITY.

The primary responsibility for safe operation of the DoE reactors is properly placed on the line organization and their contractors. Quite recently the oversight responsibility has been placed under another Assistant Secretary, in ESH. This is a good step, but to work effectively and be credible it needs some public participation and some position of authority in not allowing operation to proceed if unsafe.

The now organized system of Technical Safety Appraisal Reviews and Design Reviews need to have a parallel action plan system in the line organization which will insure the funding and execution of recommendations. It is not at all clear now how this will in fact work, especially with the time consuming Governmental budget process, which puts no special emphasis on safety.

In the commercial field the NRC authority to suspend operations until deficiencies are rectified has had success in getting the safety work done, often years before the utility can recover the costs, if ever. Such a shutdown authority in the hands of ESH might be considered. I note that the Secretary has delegated such authority to the Assistant Secretary for Environment, Safety and Health on September 12, 1986 in DOE N 5480.2.

At present the fiscal responsibility of the budget and appropration process dominates over the strictly safety process. This is a real distinction between the directly Federal operated reactors and those in the licensed commercial field, including licensed Federally owned utilities.

While it is intended that the recommendations of ESH are to be made public, in the form of the various appraisal team reports, the entire process would be more credible if a permanent system of outside overview were established. This ad-hoc review of six outside consultants is a one time thing. I trust that our reports will be made public, but what is needed is a more permenant system of overview.

Even the National Academy of Science overview appears to be a one time response. I would suggest that a separate permanent public outside review group would be helpful to the DoE. The Advisory Committee on Reactor Safeguards is such a body for the NRC. The ACRS has an established appointive system by the NRC and operating procedures and staff, and is composed of technically reputable persons from academia and industry (retired persons). A similar body appointed by the Secretary composed of qualified individuals, could add credibility to the Departmental Safety Review process.

The present contractor (UNC) is due to be replaced or re-established by October 1987. With the great importance of the management philosophy and attitude in the safe operation of the "N" reactor, it is difficult to place long term credence on how the new contractor will approach this problem until the selection is made.

The present contractor is a "special" member of INPO. I would suggest that the Department have this contractor, and his successor, make full use of the overview services of INPO, in the operations, maintenance, training and emergency preparedeness fields.

ENERGY COMPARISIONS:

There are three basic energy forms stored in a power reactor system in addition to the nuclear energy represented by the fuel and fission products.

1. Steady state stored energy. This includes mechanical energy in the form of the pressure of the coolant, and of the change of state energy available in water heated above the vapor pressure of the ambient atmosphere. While this is the smallest of the contained energy sources available it is the usual basis of the "most credible accident" design of the coolant pipe break. Graphite lattice stored energy "Wigner energy" would also be included in this category for a graphite moderated reactor, but at the operating temperatures of Chernobly-4 and "N" is of negligible quantity.

TABLE I

REACTOR PARAMETER COMPARISONS

		TMI-2	Chernobyl-4	N-Reactor
A.	Energy Potentials (All X10^6 MJ)			
	1. Steady-State Stored Energy(1)	0.39	1.91	1.89
	2. Chemical Stored Energy (Metal/Water Reactions)	0.14	1.14	2.17(2)
	3. Chemical Stored Energy (Graphite Exothermic Reactions)	0.00	0.66	0.59
B.	Potential H$_2$ Generation(3) (All X10^6 SCF)			
		0.39	3.30	6.25(2)
C.	Full-Power Adiabatic Heat-Up Rate (K/s)			
		93.0	53.0	72.0
D.	Time to melt Zr after scram (s) (Assumes 1% decay heat)	590.0	1040.(3)	765.0(3)
E.	Core Contents (metric tons)			
	1. Zirconium	21.0	177.0	195.0
	2. Uranium Metal	0.0	0.0	365.0
	3. Graphite	0.0	2000.0	1800.0

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[1] Includes structural, fuel, thermodynamic stored energy, and graphite stored energy for Chernobyl-4 and N-Reactor.

[2] Includes uranium metal-water reaction.

[3] Neglects any graphite reactions.

2. Chemical Metal-Water. This depends on temperatures achieved, and the materials involved. Principally metal-water reactions occur with steam and uranium metal, zirconium metal or alloys, and other active metals that may be present such as steel or titanium. These reactions usually release heat, and can be self sustaining, especially if aided by residual nuclear heating. The reactions evolve hydrogen gas, among other products, which can lead to deflagration or detonation when oxygen is present in the surroundings.

3. Chemical Graphite. At even higher temperatures materials such as graphite can react with oxygen, which releases heat, or with steam, such latter reaction absorbing heat. This can be a large energy source with various explosive and other products being released.

The magnitude of these various energy forms is shown in Table 1, page 5a, which compares the energy available at Chernobyl-4, Three Mile Island-2, and "N" reactors. (Prepared by Mr. John Ireland of the LANL.) Even without the graphite chemical energy, it is clear that the available chemical energy from metal-water reactions is significantly greater in "N" and Chernobyl-4, than in TMI-2. The graphite energy will probably not be involved unless a long running major accident occurs, as at Chernobyl-4.

Table 1 also shows that the potential hydrogen evolution at the "N" reactor is 20 times that of a TMI-2 and twice that of a Chernobyl-4.

HYDROGEN CONTROL:

Both at Three Mile Island-2 and at Chernoblyl-4 the large scale generation and release of hydrogen into the surrounding atmosphere was unexpected. The release into the TMI-2 containment resulted in a deflagration in a local area that did little damage. Such releases can be contained in normal U.S. commercial containments without catastrophic failure. Some containments were already inerted before the TMI-2 accident, subsequent action has required hydrogen control, either by inerting or by igniters, in many U.S. commercial plants. Over 20% are inerted in the containment during operation. (not during startup)

Aside from the reactor core itself, which is inerted for temperature and oxidization control of the graphite, "N" reactor does not now have any hydrogen control systems. "N" does not now even have a hydrogen indicating system on the inerting gas immediately around the graphite stack itself, though it has recently been recommended that such instrumentation be installed.

Chernobyl-4 did have hydrogen indicating and dilution control systems (dilution fans) in the pump and piping spaces. It also apparently had a hydrogen indication system as part of the graphite stack inert atmosphere clean-up system. Of course since the Chernobly-4 accident involved massive release of steam from multiple tube ruptures, the initial boundary rupture was by steam overpressure, any hydrogen explosions occurred moments later.

Within the heavily shielded Zone One of the "N" reactor there are a number of compartments with varying degrees of intercommunication of their atmospheres. There is little provision for mixing and none for hydrogen explosion prevention. As will be seen below I believe that some form of hydrogen control, preferably by inerting, be put in place in Zone One as a matter of high priority.

RISK/BENEFIT

Almost all human endeavors involve some balancing of risk with benefit, since nearly everything we do has some degree of risk.

The possibility of an accident involving major core damage in operating the "N" reactor is probably about the same as that from any commercial reactor. Where there is a significant difference is in the mitigation of the consequences of an accident where I believe such measures are much less than those present in commercial reactors. Thus the overall risk of release of radioactivity to the environment from "N" is significantly larger than from a commercial reactor. To the nearby population this risk is reduced somewhat by the large area of low population density (including worker population) surrounding the reactor.

This increased risk was originally accepted by the AEC because there were then in operation several older production reactors of even less safe design. These older units are all now shut down.

The benefits are two-fold, electric power generation, and the production of materials for the U.S. Defense Programs.

As regards the need for electric power generation in the region I believe I can render some judgement on the relationship between the benefits and the risks, since my technical competency covers both of those areas. The most recent forecast of Electric Power Supply and Demand for the period 1986-1995 from the North American Electric Reliability Council(June 1986) shown the North West Power Poolwinter load demand going from 32,359,000 KW in 1985 to 38,573,000 KW in 1995 or a growth rate of 1.3%. During the same time period the available resources increase from 46,509,000 KW to 48,025,000, a growth of .4%. This leaves a reserve margin of 24% in 1995.

Without "N" the margin becomes 22% assuming that it is not replaced with an electricty producing unit. None of the above figures include the WPPSS units 1 and 3 which are in mothballs, and for which there is public discussion concerning their total abandonment. Because of the favorable rate paid for steam the replacement power costs may be higher, but with the "N" reactor constituting at most 2% of the energy this effect would not be large.

From this I cannot believe that the "N" reactor electricity production is essential to the area, and indeed if this were it's only purpose I would urge that it be shutdown permenantly immediately.

It is of course impossible for me to arrive at any realistic Risk/Benefit conclusion about the need of the "N" reactor for Defense materials production. However, since it is in operation, and in past years serious consideration has been given to its replacement, or major rebuilding, I can assume that competent Governmental authorities consider that the continued operation is essential to the public good and are willing to assume the increased risk over a commercial licensed unit, but I believe this evaluation should be reconfirmed.

ADVISORY COMMITTEE ON REACTOR SAFETY (ACRS) REVIEWS.

Prior to the separation of the NRC from the ERDA/DOE the ACRS made a number of reviews of the "N" reactor. These are discussed in Appendix B to the July 1986 Design Review but three items are not disposed of in that review, because they involve policy decisions beyond the scope of the Design Review Group. These are:

a. The ACRS never made their usual determination that the "N" reactor could be operated "without undue threat to the public health and safety". Instead they determined that "N" reactor operation was acceptable because it did not increase the reactor hazards already there (old production reactors). These are now all shut down and the only two other now operating reactors are in containments, one operating under NRC license, the other under DOE.

b. The ACRS noted that operation of the "N" reactor is only justified by production requirements.

c. The ACRS noted that hazard of the "N" operation exceeds that of licensed reactors. While not explicit in their letter this appears to be because of the lack of containment. The exact statement in the March 22, 1966 letter (declassified in 1975) is:

> "As indicated in our letters of May 20 and September 17, 1965, the Committee still believes that the potential hazards associated with the Hanford reactors (as they are now confined) exceed those of licensed reactors. The Committee again points out that radiological consequences in the unlikely event of a severe reactor accident at the N-Reactor during 4000 MW(t) operation would exceed the dose guidelines now used for licensed power reactors.

> The Committee believes that the operation of the N-Reactor with the new dual purpose fuel will not increase the existing hazard (note: no longer present in 1986) to the health and safety of the public. The Committee continues to believe that continued operation of the N-Reactor without further safeguards can only be justified by production requirements."

This situation may be beyond the purview of the Design Safety Review Team, but is certainly within the responsibility of the Secretary.

"N" STATUS SHORT TERM.

The Special Safety Team made four recommendations for improvement in the "N" reactor in their May, 1986 report.

The Technical Safety Appraisal Team made fifty-one recommendations in their July 1986 report. While all are in one way or another connected to safety, and form an imposing number for an operating reactor, I find one especially serious. This is QA.16, wherein a long standing Corrective Action Request (CAR) on the confinement seals, had been cancelled without the work being done.

At the request of the UNC management a Safety Assessment of the "N" Reactor was made by INTEX in 1983. This report of June 16, 1983 (the Dietrich report) was made available to us. It apparently was not reviewed by the Technical Appraisal Team. The INTEX report made a large number of recommendations in the Programmatic, Training and Technical Assessment areas. Some of those items appear to still be unresolved.

The Design Review Team made nine principal and a large number of additional recommendations in the course of their design review as reported in their July 1986 report. They point to a number of serious long term problems, which should be given immediate attention. As discussed in the section immediatly above they identified a major policy issue as being beyond their scope.

All three of these teams seem to have made competent reviews in their areas of coverage, and I support all of the recommendations. The INTEX report recommendations are also supported by me.

The three safety review teams have made in total 88 separate recommendations, when the duplications and overlaps are taken into account. A cumulative analysis of these has been prepared by ES&H.

An action plan is being developed and should be funded to put into place positive actions to fulfill these recommendations on a fixed schedule. I would suggest a target date of no later than October 1, 1987 for all to have been physically completed, since this date coincides with the selection of a new operating contractor.

A commercial power reactor faced with such a large number of recommendations would very likely be forced to close until all were completed.

ADDITIONAL RECOMMENDATIONS.

In addition to the recommendations made by the above three teams, I believe that three other matters should be corrected to a degree which I believe exceeds the recommendations of those teams. These items would normally arise in the Probability Risk Assessment (PRA) level 3 study recommended by the Design Team which study should be expedited. These items which I believe should be completed within one year and before the PRA is completed are:

1. Study the possible effects of a longitudinal split type break in an embrittled Zirconium alloy process tube within the graphite. If such a break can lead to stresses on adjacent tubes which can propagate in the core then something like the Chernobyl accident might be possible, especially if the separate tubing of the GSCS is affected. This separate cooling system is one of the key features of "N" which Chernobyl-4 did not have, and which is important in preventing some high temperature run-away metal water reactions.

2. Provide for hydrogen control by inerting Zone One of the confinement system during power operation. This zone is not accessible during operation because of radiation hazards, and the inerting would provide a degree of protection in the very areas most likely to be exposed to deflagration or explosion. A number of commercial reactors are operating with the equivalent volumes inerted during operation. Since inerting is used in most tanker ships the equipment is available commercially.

3. Providing better physical separation for the redundant emergency water pumping systems and water supplies for the ECCS and the GSCS. Provide protection and separate ventilation for the control room, or an alternate location, during accident conditions. These items are reported to be planned, but I was unable to verify their priority and schedule (See my July 13, 1986 letter appended.)

END OF LIFE

At the July 2, 1986 meeting at Richland, WA. this subject was discussed at some length. The nominal design life of the "N" reactor was apparently twenty years, a time that is now is the past. The more important assessment is how much remaining life is acceptable, without undue hazard. There are three principal areas of concern:

1. Normal mechanical and electrical components. While there are definite problem with auxiliary boiler tubes, valves with difficult to locate replacement parts, and the normal aging of electric cable, relays and electronic components, no definite end point stands out.

2. The graphite stack. After many years of slightly shrinking the graphite stack now seems to be growing at a rate that will result in contacting the roof thermal shield in three or four more years, say 1990. This is based on information more recent than that of the July 2, 1986 meeting. Besides the possible adverse effects of such contact the strains placed on the process tubes by this change is dimensions is appreciable. The graphite growth is a function of both power level and time, and can also be modified somewhat by flux peak shaping to spread the flux more uniformly. More study of this matter is needed to determine a final end point accurately.

3. The process tubes. By one criteria, which assumes the growth of a 5 mil crack existing in 1964 at startup, the ASME Section XI limiting fracture toughness will be reached in 1991 at present power levels. This limit is again dependent on time and power level. It also needs to be studied in more detail.

At present power levels and operating times I conclude that the situation will not change much from what it is today until about 1990-1991. Operation beyond that time would have to be predicated on data still yet to be developed to justify it.

LONG TERM PRODUCTION OF DEFENSE MATERIALS.

The "Productivity assurance program" is intended to extend the life of the "N" reactor into the 21st century. This program is laid out in the GAO report of 8/5/86, with the recommendation to the Congress that it be abandoned. While this may make a recommendation by me moot, I also believe that no efforts should be made to extend the life of the present "N" reactor by such major efforts. If the production capacity is needed a new reactor is indicated, as was studied in the 1982 time frame, and abandoned, apparently for economy reasons. My reasons are:

The "N" reactor if of an unique design, like nothing else currently in operation in the world. Thus it's experience base is accrued only at the rate of one reactor-year of experience per year. Nearly all other types of reactors are acquiring experience at the rate of from 25 to 50 reactor years of experience per operating year, from similar type units operating elsewhere. This makes the problems of predicting life expectancy and risk evaluation for the "N" reactor difficult.

On the other hand there are several known problems:

1. Embrittlement of the Zirconium alloy process tubes is occuring from the irradiation. This situation is leading to the recommendation that all tubes be replaced in the early 1990's. The ASME Section XI predicted stress limits will be exceeded in 1991 under some assumptions of original crack size. This will involve the creation of a new production line to produce these tubes, since there is no other US demand for such zirconium tubing.

2. Graphite growth in the stack is beginning to reverse from a long period of slow shrinking to a period of growth. By about 1989-1990 the growth will reach a positive 2 inches, an amount about equal to the maximium shrinkage. This change bends the process tubes and thereby increases the stresses therein, as well as otherwise affecting the various openings in the graphite stack, and the internal keys, some 15% of which are reported to already be broken. At about this point it will also contact the bottom of the roof thermal shield, with potential adverse effects.

3. The present design, based on the earlier production reactors, is very man-Rem intensive during the reloading cycle. To reduce this materially by automated operation, would involve further unique designs, which in the installation and maintence would be man-Rem intensive. In addition if extensive tube replacement or graphite replacement were done the resulting operation would involve much exposure. In ALARA terms this is very undesireable. "N" reactor uses about three times the commercial average of man-Rem / year, because of its design and age.(1700 vs 600 man-Rem/year.) One replacement study indicated that operation of a new reactor could be at about half the average (300 man-Rem/year)

4. The present confinement design has real possibilities of resulting in air releases in case of unexpected accidents even after inerting Zone One. It also has the problem of surface release of the accident water, which is to be pumped from confinement into the covered cribs on the bank of the Columbia River after an accident. Having seen the conditions put upon accident water release at Three Mile Island it would appear that this situation at the "N" reactor could not be tolerated in real accident conditions.

5. The redundancy of the emergency water supply systems and control room habitability needs to be corrected as suggested above. Many other conditions which are inherent in a late 1950 design of a unique system should be corrected in a new reactor. To rectify all these in the current design would almost certainly not be cost effective. Among other problems some 750-1000 gallons per minute of radioactive primary

coolant is released directly to a sand crib, and some apparently eventually surfaces as a spring discharging into the Columbia river.

6. Of the 55 General Design Criteria established by Appendix A to 10CFR50 the "N" reactor meets or exceeds 40. (NUSAR Vol.2) It does not meet 6, partially meets 1 and meets the intent of 8 (though I question this statement on criteria 41 concerning hydrogen evolution being negligible.) In addition it doen not meet Appendix K (in that the fission product release is considered to occur after the confinement venting) and it does not meet Appendix R (in circuit separation).

7. Until the post October 1987 operating contractor is designated it is not realistically possible to understand his operating philosophy.

CONCLUSIONS AND RESPONSE TO SPECIFIC QUESTIONS.

We have been asked the following specific questions:

Q1."The consultants will review the facts and findings surrounding the Soviet reactor accident at Chernobyl."
A. I have done so. See "Lessons Learned" and "Similar Accident" above.

Q2. Based on these facts and findings, the consultants will examine the N-reactor operations and safety procedures to ensure that all key technical questions and potential safety issues raised by the Soviet accident have been considered."
A. As discussed in the sections "Hydrogen control", "N" status short term" and "Additional recommendations" I believe a number of things must be done to continue operations for the next four or five years, and that even then the hazard to the general public will exceed that from a commercial reactor in the event of a severe accident involving core melting.

Q3. "The consultants will also examine the information and findings developed by the Department's safety reviews of the N-reactor to ensure that the relevant facts and findings from the Soviet accident have been addressed by the review teams."
A. I have reviewed the three teams output and believe they have been thorough. They did not look into some important policy questions, which are discussed in my sections "Risk/Benefit" and "ACRS reviews" above. I believe these matters warrent the Departments careful consideration. Some of these matters were discussed in my July 18, 1986 letter to Dr. Trivelpiece. In particular recommendations of the safety review teams are of little use until they are implemented.

SUMMARY OF RECOMMENDATIONS.

1. The ACRS identified in 1966 the basic hazards of the "N"

reactor as follows:

> "As indicated in our letters of May 20 and September 17, 1965, the Committee still believes that the potential hazards associated with the Hanford reactors (as they are now confined) exceed those of licensed reactors. The Committee again points out that radiological consequences in the unlikely event of a severe reactor accident at the N-Reactor during 4000 MW(t) operation would exceed the dose guidelines now used for licensed power reactors."

I believe this situation is unchanged today.

While I do not believe the possibility of a severe core melt accident at "N" reactor is much different than those of commercial reactors, the measures for mitigation of the effects on employees and the public of an accident by containment measures such as are used in commercial reactors is essentially lacking at "N". Therefore I recommend that the Department shut down the "N" reactor unless a positive judgement is made that the requirements for defense material warrents accepting public hazards exceeding those of commercial reactors.

2. If continued operation for the next several years is considered to warrent acceptance of these hazards then a short term Action plan should be provided and executed based on the various sources of recommendations identified above. These are in summary:

a. Eighty-eight recommendations combining all those from the Special Safety Team, the Technical Safety Appraisal Team, and the Design Review Team.

d. Three recommendations identified above as "Additional Short term recommendations".

e. Recommendations of the 1983 INTEL report.

f. Complete a Level 3 Probability Risk Analysis with emphasis on establishing a realistic end of life criteria and date.

g. Qualify a new operating contractor as "safety concious" at the top management level.

This should all be completed within one year, by October 1, 1987, which is the time set for the introduction of a new or reappointed operating contractor. With these changes operation at the present power levels and loading can continue until 1990-1991 without risks increasing much beyond those now existing. Lower power levels could give increased life. (See section "End of Life" above).

3. If continued production of Defense materials is required long term, replace the "N" reactor by a less unique design, with provision for accident mitigation.similar to commercial reactors. This will be a challenging task, but is not a new idea. It was studied extensively in the 1982 time frame, but never executed, apparently for economy reasons.

4.I do not consider the proposed Production Assurance Plan for the"N" reactor to be an adequately safe long term solution. Continued operation without process tube and graphite stack replacement is going to be increasingly hazardous. Replacement will be a costly and difficult task both in dollars and in man-Rem.

Louis H. Roddis, Jr.,PE
Consulting Engineer.

cc: M.C. Leverett.
H.W. Lewis.
T.H. Pigford.
G.F. Tape.
E.P. Wilkinson.
M.S. Smith.
J.R. Ireland.
G. Graves.

REFERENCES JOINT BRIEFINGS AND SPECIAL MEETINGS:

Appendix 1. Charge letters, news release, and biography. Attached.

Appendix 2. Bibliography. Attached.

Appendix 3. Joint Briefings. Attached.

Appendix 4. Special Briefings. Attached.

Appendix 5. N-Reactor and Typical RBMK-1000 Comparisions.

Appendix 6. My letter of July 18, 1986 to Dr. Trivelpiece, Director of Energy Research, requesting additional information on behalf of all six of the consultants.

In addition to the Bibliographical material and Briefings and Special Meetings identified in the Appendices attached I had the following individual meetings concerning this subject:

May 9, 1986. GA Technologies, San Diego, CA. Msrs. H. Agnew, T. Johnson, A. Baxter.
Subject: Chernobyl-4 and graphite combustion.

May 10, 1986. Phone call. Dr. Thomas Cochran. Regarding his testimony of May 7, 1986 (Ref. 15.)

July 2, 1986. Richland WA. R.L. Ferguson Assoc. Msrs. R.L. Ferguson and John Honekamp. NW power pool generation planning and WPPS1/4 status.

The following individual references were also used.

R-1. 1986 Electric Power Supply and Demand, for 1986-1995. North American Reliability Council, June 1986. Princeton, N.J.

R-2. Northwest Energy News. February/March 1986. Northwest Planning Council.

R-3. Letter John Ireland Q-DO/TR-86-75 of June 27, 1986 to me. Subject: Energy Potential Comparisions for Chernobyl-4, N-Reactor, and TMI-2.

R-4. Letter John Ireland Q-DO/TR-86-74 of June 26, 1986. Subject: Adiabatic heatup-rate comparisions for Chernobyl-4, N-Reactor, and TMI-2.

R-5. DOE Notice DOE N 5480.2 of 19-12-86, expires 1-3' 88. Subject: Emergency Suspension of Operations.

R-6. Draft Action Plan to address recommendations from the "N" Reactor. Forwarded 8/15/86. Including recommendations from:
Special Safety Review.
Technical Safety Appraisal.
Design Review.

R-7. UNC letter Gary L.Smith to Dr. Thomas H. Pigford, September 12, 1986. CORRAL anaylsis and Emergency Response Guide.

R-8. UNC letter Gary L. Smith to Dr. Thomas H. Pigford, September 15, 1986. "Hypothetical Dose Consequences Versus Increased Building Leakage".

R-9. Mary L. Walker, Assistant Secretary, Environment, Safety and Health, to The Under Secretary of September 3, 1986. Subject: Cumulative Analysis of EH's N Reactor Reviews.

R-10. Goetz K. Oertel, EH-30 to Mary L. Walker, EH-1 of August 28, 1986. Subject: Cumulative Analysis of N Reactor Reviews.

R-11. Victor Atiyeh, Governor, State of Oregon, to The Honorable John S. Herrington of August 27, 1986 and enclosure thereto entitled " A Report to Governor Vic Atiyeh on N-Reactor Safety" of August 12, 1986.

Appendix [illegible] 1.

THE SECRETARY OF ENERGY
WASHINGTON, D.C. 20585

May 2, 1986

Dr. Louis H. Roddis, Jr., P.E.
P.O. Box 1513
Charleston, SC 29402

Dear Dr. Roddis:

The recent accident involving the Soviet reactor at Chernobyl has resulted in increased public concern about the safety of nuclear reactors, including those operated by the Department of Energy (DOE). The Department has only one reactor that has design characteristics that are even remotely similar to those of the damaged Soviet reactor. It is the N-Reactor located in Hanford, Washington. This reactor is used primarily for the production of nuclear weapons material, but it also produces electricity. Even though it has an outstanding safety record, I want to be absolutely certain that it is being operated safely and that there is no possibility of an accident similar to the one that occurred in the Soviet Union.

Shortly after being appointed Secretary of Energy, I approved a series of health, safety and environmental initiatives to examine all aspects of the Department's operations. One of these initiatives is the Technical Safety Appraisals of the Department's nuclear facilities to be conducted on a systematic basis over the next few years. In view of what happened in the Soviet Union, I have decided to accelerate the schedule for the planned safety review of the N-Reactor in order to complete that effort as soon as possible.

In addition, I have decided to invite an ad hoc group of experts, which I am asking you to chair, to assist the Department by ensuring that we have examined all of the key technical questions and probed into all the potential safety issues raised by the Soviet incident. While members of the group will be free to consult with one another in any way they choose, it is the individual expertise and individual advice, from each member, that the Department is seeking. The information and findings developed from the Department's safety reviews of the N-Reactor will, of course, be made available to each member of the group.

I have asked Dr. Alvin W. Trivelpiece, Director of the Office of Energy Research, to assist you in bringing this group together and conducting your review.

This is obviously a matter of great national importance and needs to be started as soon as possible. I know that until you have met and determined what needs to be done you cannot forecast when your work will be completed, but given the urgency I would hope that you could complete your review in a few weeks.

I greatly appreciate your willingness to help us in this important endeavor.

Yours truly,

John S. Herrington

John S. Herrington

Appendix 4 page 3.

NUCLEAR

OFFICE OF THE PRESS SECRETARY
WASHINGTON, DC 20585

DOENEWS

NEWS MEDIA CONTACT:
Gail Bradshaw, 202/252-5810

FOR IMMEDIATE RELEASE
MAY 5, 1986

HERRINGTON ASKS EXPERTS TO ASSIST IN REVIEWING SAFETY OF DEPARTMENT'S N-REACTOR

Energy Secretary John S. Herrington has established a special safety review panel, composed of nationally recognized scientific and technical experts, to help review the safety of the department's N-Reactor, near Richland Washington.

Louis H. Roddis Jr., consulting engineer and former President of Consolidated Edison Company of New York will chair the effort, assisted by Dr. Gerald Tape, former President of Associated Universities, Inc. Biographies of both are attached. Another three to four experts will be added over the next several days.

"The N-Reactor is the only one the department operates which has design characteristics even remotely similar to those of the damaged Soviet reactor," Herrington said.

"Even though it has an outstanding safety record, I want to be absolutely certain that N-Reactor is being operated safely and that there is no possibility of an accident similar to the one that occurred in the Soviet Union," Herrington added.

Each member of the special panel is being asked to provide candid, individual views in order to "assist the department by ensuring that we have examined all of the key technical questions and probed into all the potential safety issues raised by the Soviet incident."

(MORE)

Appendix 1 page 4.

The panel will have access to all available information about the accident at Chernobyl and about N-Reactor, including the department's internal safety reviews of N-Reactor, and will be assisted by DOE Director of Energy Research Dr. Alvin Trivelpiece.

The panel's activities will parallel a DOE review of the N-Reactor ordered last week by Secretary Herrington.

The internal review will be under the direction of Assistant Secretary for Environment Safety and Health Mary Walker and will involve three steps:

- o A special safety review team begins on Monday, May 5, to look at specific aspects of safety, such as fire protection related to the graphite moderator used in the reactor. That review is expected to be completed within a few days.
- o A DOE team also begins that day to review N-reactor's design and the safety upgrades which have been put in place since the plant was built. That is expected to be completed in about two months.
- o A comprehensive DOE technical safety appraisal of the plant that originally was to have begun in September, 1986 has been rescheduled to begin May 19.

Technical safety appraisals are among initiatives which Secretary Herrington announced in 1985 to ensure the safety and environmental compliance of all of DOE's facilities.

The N-Reactor is a heavily instrumented, graphite moderated reactor that is cooled by normal water. Construction was completed in 1963. The primary purpose of the N-reactor is to produce nuclear material for national defense, but byproduct steam is sold to the Washington Public Power System for generating electricity. N-Reactor is operated for the DOE by UNC Nuclear Industries, Inc.

-DOE-

-86-073

Appendix 1 page 5.

U.S. DEPARTMENT OF ENERGY
OFFICE OF THE PRESS SECRETARY
WASHINGTON, DC 20585

DOENEWS

NEWS MEDIA CONTACT:
Gail Bradshaw, 202-252-5806

FOR IMMEDIATE RELEASE
May 7, 1986

HERRINGTON FILLS OUT EXPERT CONSULTANT PANEL REVIEWING N-REACTOR

Energy Secretary Herrington today named four additional outside persons to the special panel whose members will review the safety of the department's N-Reactor, near Richland, Washington.

The four experts named today are:

Dr. Thomas Pigford, Chairman of the Nuclear Engineering Department, University of California, Berkeley;

Admiral Eugene P. (Dennis) Wilkinson, private consultant and former President and Chief Executive-Officer of the Institute for Nuclear Power Operations;

Dr. Miles C. Leverett, private consultant and former research manager in nuclear reactor safety for the General Electric Company for 25 years; and

Dr. Harold Lewis, nuclear physics professor, University of California at Santa Barbara.

"These consultants are uniquely qualified to review the Chernobyl incident and N-reactor operations and safety procedures," Herrington said. "They add an extra dimension to the Department's efforts to ensure the safety of N-reactor."

The four join Louis H. Roddis Jr. of Charleston, S. Car [illegible] Gerald F. Tape of Washington, D.C., who were named May 5.

(MORE)

R-86-074

Each of the experts will examine the technical and safety aspects of the N-Reactor in light of the Chernobyl Reactor Accident. They will:

- Review the facts and findings surrounding the Chernobyl accident.
- Based on those facts and findings, they will examine N-Reactor operations and safety procedures to ensure that all key technical questions and potential safety issues raised by the Soviet accident have been considered.
- Examine the information and findings from the department's own safety reviews of N-Reactor to ensure that the relevant facts and findings from the Chernobyl accident have been addressed by the DOE teams.

N-Reactor is owned by DOE and is operated primarily to produce nuclear materials for national defense.

-DOE-

R-86-074

(Note to Editors: Biographies of the six panel members are attached.)

Appendix 1 page 7.

Louis H. Roddis, Jr.
Brief Biography.

Louis H. Roddis, Jr. , Consulting Engineer, is a Director of Detroit Edison Company, Gould Inc., Gould Government Systems Inc., Hammermill Paper Company, and Research-Cottrell Inc. He is a consultant to several governmental agencies and private companies in the energy, utility and marine fields. He is active in the historic redevelopment of downtown Charleston, S.C.

After service in World War II, including the Pearl Harbor action, and while still an officer in the United States Navy, Mr. Roddis participated in the design of the USS NAUTILUS and other early Navy nuclear projects, serving under Captain H. G. Rickover, beginning in 1946. He became a member of the Atomic Energy Commission's Division of Reactor Development at its inception in 1949 and was the Deputy Director when he left in 1958 to assume the presidency of Pennsylvania Electric Company, one of the operating subsidiaries of the General Public Utilities Corporation. While with Penelec the company was awarded the industry's coveted Edison Award for extra-high voltage transmission development, and construction was begun on the three large coal fired mine mouth power stations now operated by Penelec.
Mr. Roddis joined the Consolidated Edison Company of New York in 1969 and served as President 1969-74. During that time Consolidated Edison acquired six large floating gas turbine power plants and became known as a leader in energy conservation in the electric and gas utility industry. After service in the Federal Energy Administration in 1975 he entered the consulting profession, first as President of John J. McMullen Assoc. Inc., and then as an independent consultant. Throughout his career in the marine and public utility fields, Mr. Roddis has been active in a wide variety of public service, charitable, industrial, and trade organizations. He was Chairman of the Maritime Research Advisory Board of the U.S. Department of Commerce and Chairman of the Energy Research Advisory Board of the U.S. Department of Energy. He was the only industrial member of the Environmental Panel of the President's Science Advisory Committee, which submitted the report"Restoring the Quality of our Environment" to President Johnson in 1965.
He was the honor graduate of the U.S. Naval Academy in 1939 and is a Captain (Ret.) in the Naval Reserve. He holds a Masters Degree in Naval Architecture and Marine Engineering from the Massachusetts Institute of Technology and is the author of numerous technical papers, including the section on Nuclear Power in Mark's Standard Handbook for Mechanical Engineers. He received the Atomic Commission's Outstanding Service Award in 1957 and the U.S. Department of-Energy's Exceptional Service Award in 1984.
He was elected to the National Academy of Engineering in 1967, and is a Registered Professional Engineer in South Carolina, New York, Pennsylvania, New Jersey and the District of Colombia, and is a Chartered Engineer in the United Kingdom. He is a past Director of the Edison Electric Institute and of the American Gas Association, and a past President of both the Atomic Industrial Forum, and the American Nuclear Society. He is a Fellow of the American Association for the Advancement of Science, the American Society of Mechanical Engineers, The Royal Institution of Naval Architects. and the American Nuclear Society. He is a member of the American Institute of Electrical and Electronic Engineers, the Society of Naval Engineers, the American Society of Naval Architects and Marine Engineers. the Association of Energy Engineers, the Human Factors Society. and the National Society of Professional Engineers.
Mr. Roddis was born in Charleston, S.C. in 1918. He and Mrs. Roddis [illegible] historic district of Charleston.

[illegible] 1985
[illegible]-0319

P.O. Box 1313
Charleston, S.C. [illegible]

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1st Joint Briefing
May 22-23, 1986
DOE--Forrestal Building
Washington, DC

Consultants Present: Roddis, Tape, Pigford, Lewis, Leverett

Speaker	Title & Organization	Subject
E. Hanrahan	Special Assistant to the Under Secretary (DOE)	EPA Task Force on Chernobyl
D. Bunch	Deputy Assistant Secretary for Nuclear Energy, DOE	Chernobyl Accident
M. Walker	Assistant Secretary for ES&H, DOE	DOE Reviews of N-Reactor
G. Oertel,	Deputy Assistant Secretary for Safety, Health & Q.A., DOE	Quick Response Safety Review of N-Reactor in Light of Chernobyl
N. Klug	Team Leader for N-Reactor Special Safety Review, DOE	
C. Simpson,	Director of Office of Nuclear Materials Production, DOE	N-Reactor Safety Programs
J. Ford	Office of Nuclear Materials Production, DOE	
J. Salgado,	Under Secretary, DOE	Briefing to Consultants on DOE Issues Concerning Chernobyl and N-Reactor
S. Foley,	Assistant Secretary for Defense Programs, DOE	
M. Walker,	Assistant Secretary for ES&H, DOE	
A. Trivelpiece,	Assistant Secretary for Energy Research, DOE	
E. Hanrahan	Special Assistant to the Under Secretary, DOE	

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2nd Joint Briefing
June 12-13, 1986
DOE--Forrestal Building
Washington, DC

Consultants Present: Roddis, Tape, Pigford, Lewis

Speaker	Title & Organization	Subject
T. Johnson,	Vice President, GA Technologies	Chernobyl Accident Sequence
A. Baxter	Engineer, GA Technologies	
L. Dodd	Manager, Advanced Energy Concepts PNL	Chernobyl Accident
R. Laney	Independent Consultant and former Deputy Director for ANL	Leningrad AES Visit
J. Meinhardt,	Deputy Assistant Secretary for Nuclear Materials, DOE	N-Reactor Safety Issues & Safety Analyses
C. Simpson,	Director of Office of Nuclear Materials Production, DOE	
J. Ford,	Office of Nuclear Materials Production, DOE	
E. Goldberg,	Deputy Manager, RLO, DOE	
L. Leach,	Vice President, Programs & Planning UNC	
G. Smith	Manager, Technology Division, UNC	
V. Stello	Executive Director for Operations, NRC	NRC Response to Chernobyl Accident
M. Walker,	Assistant Secretary for ES&H, DOE	Status Report on N-Reactor Design Review and Technical Safety Appraisal Reports
H. Field,	Team Leader, Technical Safety Appraisal Team, DOE	
G. Smithwick,	Deputy Assistant Secretary for Environment, DOE	
H. Kouts	Chairman, Department of Nuclear Energy, BNL	May 1986 Meeting on Chernobyl Current Findings
---	---	Classified Briefing
---	---	Classified Briefing

3rd Joint Briefing
June 30-July 2, 1986
Richland, Washington

Consultants Present: Roddis, Tape, Pigford, Lewis, Wilkinson, Leverett

Speaker	Title & Organization	Subject
M. Lawrence	Manager, RLO	Introduction
G. Elderkin,	Program Manager, Atmospheric Sciences Program, PNL	PNL Briefings on Chernobyl Accident
L. Dodd,	Manager, Advanced Energy Concepts, PNL	
W. Little,	Staff Member, PNL	
L. Pederson	Staff Member, PNL	
L. Leach,	Vice President, Programs & Planning, UNC	N-Reactor Plant Tours* (entire reactor site, training simulator, and Zone-1)
M. Payne,	Director, N-Reactor Plant, UNC	
R. Pyzel,	Program Director, UNC	
D. Watson	Simulator Operations, UNC	
G. Smith,	Manager, Technology Division, UNC	Evaluation of Hydrogen Burns
L. Muhlestein	Westinghouse Hanford Company	
R. Hobbins	Consultant, Department of Nuclear Reactor Research and Technology EG&G Idaho	Hydrogen Generation Issue
J. Schmidt	Program Director, Productivity Retention, UNC	Confinement Pressure Capability
H. Toffer	Manager, Advanced Technology & Physics, UNC	Fission Product Release and Short Period Event
N. Miller	Technical Assistant to the President, UNC	Anticipated Transient without Scram
P. Carlson	Manager, Safety Assessment & Analysis Section, UNC	Common Mode Failures
J. Kelly	Manager, Preliminary Engineering UNC	Safe Shutdown from Safe, Remote Location
L. Leach	Vice President, Programs & Planning, UNC	Production Assurance Program
R. Barber	Director of Nuclear Safety, DOE	ES&H Design Review of N-Reactor

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*For the Zone 1 tour, consultants attended a one-hour Radiation Safety Indoctrination course, suited up, and then toured front/back/top faces of reactor.

R. Henry	Consultant, Fauske & Associates	Accident Analyses for N-Reactor
L. Ybarrando	President, Ybarrando & Associates	Design Performance for N-Reactor
E. Field	Team Leader, Technical Safety Appraisal Team, DOE	N-Reactor Technical Safety Appraisal
P. Turner,	RLO Emergency Preparedness Coordinator, DOE	Emergency Preparedness
F. Galegar	Manager, Emergency Planning, UNC	
M. Lawrence	Manager, RLO	Exit Interview with Roddis, Lewis

4th Joint Briefing
July 14-16, 1986
Los Alamos, New Mexico

Consultants Present: Roddis, Tape, Pigford, Lewis, Wilkinson, Leverett

Speaker	Title & Organization	Subject
T. Hirons	Energy Division Leader, LANL	Introduction
J. Taylor	Staff Member, ORG 311, SNL	Chernobyl Sequence of Events
R. Haarman,	Safety Assessment Group Leader, Q-6, LANL	N-Reactor PRA Status and Safety Review Work
D. Stack	Staff Member, Safety Assessment Group, Q-6, LANL	
T. Suchocki	Staff Member, Safety Assessment Group, Q-6, LANL	Savannah River PRA Conclusions
F. Sciacca	Consultant, Science & Engineering Associates	CONTAIN Code Models
D. Smith,	Chief, Nuclear & Facility Safety RLO, DOE	Unusual Occurrence Events at N-Reactor
N. Miller	Technical Assistant to the President, UNC	
---	---	Classified Briefing
---	---	Classified Briefing

Appendix 3 page 6.

5th Joint Briefing
September 3-4, 1986
DOE--Forrestal Building
Washington, DC

Consultants Present: Roddis, Tape, Pigford, Lewis, Wilkinson (present on September 3), Leverett

Speaker	Title & Organization	Subject
M. Walker	Assistant Secretary for ES&H, DOE	Status of ES&H Reports on N-Reactor
D. Bunch	Deputy Assistant Secretary for Nuclear Energy, DOE	IAEA Vienna Meeting on Chernobyl Accident, August 25-29, 1986
A. Trivelpiece	Assistant Secretary for Energy Research, DOE	DOE Response to Information Requested by Consultants on July 18, 1986
S. Foley,	Assistant Secretary for Defense Programs, DOE	Status of Action Plan for N-Reactor
A. Trivelpiece	Assistant Secretary for Energy Research, DOE	

Special Appointment
August 1, 1986
DOE-Forrestal Building
Washington, DC

SUBJECT: Request for Additional Information

Consultants Present: Roddis, Tape, Wilkinson

DOE Representatives Present:

J. Salgado, Under Secretary, DOE

M. Walker, Assistant Secretary for ES&H, DOE

A. Trivelpiece, Assistant Secretary for Energy Research, DOE

J. Gilbert, Executive Assistant to the Assistant Secretary for Defense Programs, DOE

E. Hanrahan, Special Assistant to the Under Secretary (DOE)

Appendix 4 page 2.

Special Appointment
May 6, 1986
DOE-Forrestal Building
Washington, DC

SUBJECT: Meeting to Define Charter of Consultant Review Group

Consultants Present: Roddis, Tape

DOE Representatives Present:

J. Salgado, Under Secretary, DOE

M. Walker, Assistant Secretary for ES&H, DOE

A. Trivelpiece, Assistant Secretary for Energy Research, DOE

S. Foley, Assistant Secretary for Defense Programs, DOE

Appendix 4 page 3.

Special Meeting
June 20, 1986
DOE-Forrestal Building
Washington, DC

SUBJECT: Chernobyl Briefing for DOE by M. Rosen, Director of Nuclear Safety, IAEA

Consultants Present: Roddis, Tape

N-REACTOR AND TYPICAL RBMK-1000 COMPARISONS

A. Overall Design Characteristics	N-Reactor	RBMK-1000
Reactor type	Horizontal pressure tube-pressurized water-graphite moderated	Vertical pressure tube-boiling water-graphite moderated
Design power generation (MWt)	4080	3140
Electrical power generation (MWe)	860	1000
Inlet temperature (avg. ^{o}F)	400	518
Outlet temperature (avg. ^{o}F)	543	543
Average steam quality at core exit (%)	0.0	14.5
Operating pressure (outlet psia)	1600	1037
Total reactor coolant flowrate (lb/h)	83.2×10^6	82.5×10^6
Total number of pressure tubes	1003	1693
Lattice spacing	9 in. vertical x 8 in. horizontal	9.8 in. x 9.8 in.

B. Fuel Design		
Design	Tube-in-Tube Annular	Two 3.5 m 18 rod elements in series
Fuel material	U-metal	UO_2
Amount (MT)	365	192
Length (ft.)	34.8	22.96
Orientation	Horizontal	Vertical
Enrichment (%U^{235})	0.7-1.25	1.8-2.0
Average burnup (MWD/MTU)	1000	20,000
Maximum channel power (MW_t)	5.0	3.0
Cladding	Zr-2	Zr/Nb
Pressure tube OD (in.)	3.26	3.46
Pressure tube wall thickness (in.)	0.275	0.157
Pressure tube material	Zr-2	Zr/Nb

C. Moderator Design		
Material	TSX graphite	Graphite
Operating temperature (^{o}F)	932	1292
Amount (MT)	1800	2000

D. Refueling	N-Reactor	RBMK-1000
	During shutdown	On-line
E. Loop Design		
System material	Carbon steel	Austenitic stainless steel
Equipment cells	6	2
Independent flow loops	1	2
Steam drums (total/per loop)	None	4/2
Steam generators (total/normally operating)	12/10	None
Steam pressure (psia)	150	995
Steam flowrate (lb/hr)	14.0×10^6	12.0×10^6
Main coolant pumps (total/normally operating)	6/5	8/6
F. Control-Rod System		
Type	Boron carbide encased in titanium, driven by pressurized accumulators horizontally into reactor.	Boron steel segments encased in aluminum, lowered by gravity and retrieved by servomechanisms from above through a cable.
Number of control assemblies	84	211
Neutron absorption material	Boron in B_4C	Boron steel
Control rod spacing	32 in. horizontal 36 in. vertical	19.7 in. x 19.7 in.
Drive	Hydraulic (with accumulators)	Gravity
Control rod full insertion time (s)	2.5	20

G. Safety Shutdown System	N-Reactor	RBMK-1000
Type	Boron in boron oxide balls contained in hoppers above individual moderator channels. Release is spring loaded and held by electromagnetic system in a "fail-safe" manner.	Same as control rod assemblies
Number of safety shutdown assemblies	107	21
Neutron absorption material	Boron in B_4C	Boron steel
Drive	Gravity	Gravity
H. Radionuclide Release Control System		
Type	Confinement system employing initial steam release from vent valves followed by high efficiency filtration of releases.	Partial steam suppression of releases from the reactor cavity, inlet piping, and pumps in bubbler pond below reactor.
Enclosure	Entire reactor, coolant system and reactor gas system.	Lower half of reactor and lower half of piping system.
Function	Confine radionuclides from the reactor and contaminated piping systems.	Condense steam from pipe break or steam separator relief valves.
Design pressure	+5.0 psig to -2.0 psig	Enclosure areas designed to 58 psia

A final session for joint briefings on the IAEA meeting of August 25, 1986, has been scheduled in Washington, DC for the consultants on September 3-4. At that time, the consultants have requested that information be provided on official DOE positions in two other areas:

(1) Modifications: It has been unclear what the Department's official position is on the following modifications of safety-related systems that are of concern to us:

   a. Addition of an independent, redundant ECCS,
   b. Safety upgrade of the GSCS,
   c. Improvement of control room habitability under accident conditions and addition of remote shutdown capability, and
   d. Containment of radioactive liquids produced under normal operational and accident conditions.

(2) Implementations: There are a number of deficiencies already identified that are unresolved and will be a number of recommendations in the ES&H reports. While we are in Washington in September, we would like to have a coordinated list of the deficiencies and recommendations in order of priority and a copy of the Department's action plan to close on the deficiencies and to implement the recommendations.

Sincerely yours,

Louis H. Roddis, Jr.
Chairman
Panel of Expert Consultants

cy: G. P. Tape
    T. H. Pigford
    M. C. Leverett
    H. W. Lewis
    E. P. Wilkinson
    L. M. Smith, DOE/ER
    J. R. Ireland, LANL

Appendix 6 page 1.

JUL [illegible] 1986

Dr. Alvin W. Trivelpiece
Director
Office of Energy Research, ER-1
US Department of Energy
Washington, DC 20585

Dear Dr. Trivelpiece:

On behalf of the Expert Consultants, I am exercising my position as Administrative Chairman to request additional information concerning the N-Reactor. During the course of both joint and individual briefings, the six consultants have made specific information requests for data extending beyond those presented at the briefings. When this information has been readily available, it has been provided promptly.

There are two areas, however, that are considered critical to N-Reactor safety. Questions have been raised in these areas that remain unanswered either because preparation of the information requested requires substantial commitment of people and dollar resources or has been given a lower priority than the consultants believe is appropriate for the present situation. The information requested is considered essential to the individual consultant evaluations and recommendations for the key N-Reactor safety issues raised by the Chernobyl accident.

(1) Technical area: Information has been requested on the amounts, rates of generation, and potential remedies for evolution of hydrogen under hypothetical conditions at N-Reactor more realistic than those covered in the NUSAR. An evaluation using current calculational methods would provide the information and should include the distribution of hydrogen potentially evolved in the confinement area of N-Reactor Zone 1, and the potential for control of the hydrogen. It is necessary also to include in the evaluation the adequacy of the radioactive removal system in the confinement, the adequacy of venting to relieve pressure before radioactivity is released to the confinement, and the effectiveness of the graphite and shield cooling system (GSCS) in reducing metal-water reactions during rapid transients.

(2) Operations area: During the joint briefings at Richland, Washington, and the tour of the N-Reactor, questions on operational issues related to safety were raised that were based on INPO criteria and the experience of the consultants in commercial and military nuclear programs. The issues concern training, interfaces, and emergency preparedness, among others. With the constraints of time on UNC contractor personnel and in order to provide Secretary Herrington with our reports on a timely basis, we believe UNC could take advantage of their participation in INPO to request from the Institute an accelerated evaluation of N-Reactor operations. This evaluation would provide essential information that the consultants need for their reports.

UCB-NE-4089

Chernobyl and the N-Reactor at Hanford

A Report To

John L. Herrington, Secretary
United States Department of Energy

by

Thomas H. Pigford
Berkeley, California

October 6, 1986

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1. SUMMARY

The reactor accident at Chernobyl tells us again, as at Three Mile Island, that unanalyzed and unforeseen accidents can happen, from design or operator error or both. Relying on a specified design-basis accident is not sufficient to assure safety. Accident analysis should include accidents involving operator error and severe core damage.

The N reactor at Hanford cannot experience a severe power-excursion accident of the type that occurred at Chernobyl. However, the Soviet accident focuses on issues that are relevant to the safety of the N reactor, including the need for adequate containment or confinement of radioactivity that can be released in a severe accident and the need for close attention to training, procedures, and management of nuclear safety.

Uncertainties in the technical basis for predicting performance of the N-reactor confinement system now question the level of safety that was concluded in the 1978 safety review of the N reactor. Also, the N reactor does not meet some of the tighter standards of safety that have evolved in the commercial nuclear industry after the accident at Three Mile Island.

It is recommended that the Department of Energy give high priority to the following:

1. Determine the standards for risk and safety for the N reactor that are justified by the benefits from operating the N reactor.

2. Resolve the uncertainties in performance of the N-reactor confinement system.

3. Install a hydrogen-mitigation system for the N-reactor confinement. Calculate local concentrations of hydrogen in the confinement compartments to aid in designing the hydrogen-mitigation system.

4. Install a confined basin or tank to contain radioactive liquids that will be pumped from the confinement during an accident.

5. Update the 1978 safety analysis of the chemical form and amounts of fission products that will be evolved from overheated fuel during severe accidents.

6. Extend the safety analysis to include accidents that can develop higher fuel temperatures, larger quantities of hydrogen, and different chemical and physical forms of fission products released from overheated fuel, including accidents involving equipment failure and operator error.

7. Re-evaluate the performance of the radioactivity removal system that is part of the N reactor confinement.

8. Develop realistic predictions of confinement performance symptoms to aid training and emergency procedures.

9. Arrange for the N-reactor operating organization to become an active information-sharing participant with the Institute of Nuclear Power Operations (INPO), to implement the safety-management practices established for the commercial reactor industry, to have its training program accredited by the National Academy for Nuclear Training, and to be audited periodically by INPO. "

These recommendations for near-term action should not await the more lengthy formalism and completion of a probabilistic risk assessment that will take at least a year.

It is also recommended that the Department of Energy sponsor more detailed safety analysis to better understand and to learn from the reactor accident at Chernobyl.

2. THE CHARGES TO THE CONSULTANTS

On May 7, 1986, shortly after the reactor accident at Chernobyl, Secretary of Energy John L. Herrington requested six consultants to review safety issues of the N-reactor at Hanford, Washington. The charges to the consultants were [1]:

> "The consultants will review the facts and findings surrounding the Soviet reactor accident at Chernobyl.
>
> Based on these facts and findings, the consultants will examine N-reactor operations and safety procedures to ensure that all key technical questions and potential safety issues raised by the Soviet accident have been considered.
>
> The consultants will also examine the information and findings developed by the Department's safety reviews of the N-reactor to ensure that the relevant facts and findings from the Soviet accident have been addressed by the review teams."

On May 23, 1986 Under Secretary Salgado asked the consultants to also address the following questions:

> "Are all important issues being adequately addressed?
>
> Is the N reactor being operated safely?
>
> Can the N reactor be operated safely?"

Each consultant was requested to submit an individual report.

3. STANDARDS FOR ASSESSING N-REACTOR SAFETY

The charges and questions to the consultants require us to assess the safety adequacy of several features of the N reactor. To reach a finding on adequacy of safety requires a standard of what level of safety is adequate. The standard used herein is that specified by the 1978 updated safety analysis of the N reactor [2], referred to as the NUSAR. Also, new safety issues that affected the analysis of commercial-reactor safety emerged after the reactor accident at Three Mile Island and were reinforced by the Chernobyl accident. Many of the post-TMI safety issues are relevant to the N reactor and imply additional standards of safety that were not fully considered in the 1978 NUSAR review. Congressional testimony by Department of Energy officials after Chernobyl and portions of the Department's recent technical appraisal reports on N-reactor safety suggest that some of these new commercial-reactor safety issues should be considered for the N reactor, as is done herein. Consequently, the standards being applied to N-reactor safety are more restrictive than those adopted for the 1978 safety review.

There is no determination here of whether risks of N-reactor operation are balanced by the benefits from that operation. The consultants have not received or sought information on benefits from weapons production, so we have no basis for reaching a finding on N benefits and risks. Therefore, there is no basis for a consultant finding on whether risks from N should be acceptable. The determination of whether benefits justify the risks should be made by the Department of Energy.

4. DIAGNOSIS OF THE CHERNOBYL ACCIDENT

The reactor accident at Chernobyl resulted in part from the reactor operating under conditions where nuclear reactivity increases when liquid water in the reactor turns to steam, i.e., a positive void coefficient of reactivity [3]. The void coefficient is reported to become negative in the region of high steam content [4]. When the reactor was operating at low-power for a turbine coast-down experiment with some safety systems improperly disengaged and the reactor coolant channels nearly filled with liquid water, improper operator actions caused water to boil, the nuclear reactivity and heat-generation rate increased, more steam was formed, and the reactor quickly generated enormous power and steam pressure until finally terminated by excessive heating of the fuel and more extensive steam voiding. The steam explosion ruptured pressure tubes and blew off the top lid that isolated the reactor compartment from the building atmosphere. The N reactor has a negative void coefficient over its entire range of operation, so this type of nuclear runaway cannot occur.

The design error of the positive void coefficient was compounded by operator error, inadequate procedures, an inadequately designed containment, and the generation and explosion of hydrogen of hydrogen from reactions of hot zirconium metal with water and steam. These are issues relevant to the N reactor, although the details in which they could become involved in an accident are not the same at N as at Chernobyl.

The importance of graphite in the Chernobyl accident is not clear. Pieces of burning graphite ejected from the reactor contributed to the building fire, and hot graphite in the reactor burned and contributed to continued but slower release of radioactivity after the first explosions. Graphite burning does not appear to have been a root cause of the Chernobyl accident, and it seems unlikely to be a significant safety issue at the N reactor as long as the N confinement system remains intact. Graphite may have kept the Chernobyl reactor fuel from melting down to the bottom of the reactor, and it would be expected to act similarly at the N reactor.

The potential for graphite to react with hot water and steam to absorb heat and to generate hydrogen and carbon monoxide may not have been important in the Chernobyl accident, and it does not seem important at the N reactor.

The DOE Design Review Team [5] points out that the fuel channels in the Chernobyl reactor are vertical and that those in the N reactor are horizontal, and it projects greater safety from horizontal channels, on the basis that vertical channels promote more rapid hydrogen generation and that there will be less buoyancy-driven air flow in horizontal channels if air reaches the hot reactor. The suggestion is plausible, but no analysis is provided by the Design Review Team. The overall flow pathway, with its resistances and elevation changes, would have to be considered. For accidents that involve overheated fuel and metal-water reactions, the possibility of slugs of water reaching the dry overheated fuel in horizontal channels, such as by operator error, should be considered. The vertical channels in the N reactor for the backup control absorbers should also be considered.

These are the principal Chernobyl issues that are considered in this N-reactor review. There are many other design differences between the Chernobyl and N reactors, and there are many other Chernobyl issues, such as emergency response, that could be issues at the N reactor, but they are not considered in this report.

An overriding observation from the Chernobyl accident is that the design-basis accident is not necessarily the worst accident that can happen. Serious and unexpected accidents can happen, involving design and operator errors. At Chernobyl the condition to initiate the rapid transient and explosion was approached slowly, with ample time for operator reflection and correction. The same was true for the accident at Three Mile Island. If events are allowed to proceed uncorrected, a delicate condition can be reached wherein severe damage can occur rapidly and uncontrollably, as in the reactivity transient and steam explosion at Chernobyl and the rapid reaction of steam with zirconium metal at Three Mile Island. Some of these unexpected accidents can be anticipated by more thorough analyses of events, including those involving operator error, that can lead to accidents. These experiences also argue for adequate post-accident mitigation systems to protect against the accident that has not been planned for, such as adequate containment or confinement of released radioactivity. The adequacy of the N confinement system is a focus of this review.

It is clear from the Soviet report [3] of the Chernobyl accident and from the August meeting in Vienna that the events that occurred during the steam explosion and the following hydrogen explosion are poorly understood. It is these details that will be most helpful in identifying technical lessons learned at Chernobyl and applying them, where relevant, to the N reactor and to other U.S. reactors. However, the U.S. has done too little to study and diagnose the chernobyl accident in a way that can benefit the U.S. reactors, a far cry from the active and thorough diagnostic studies by government and industry after the accident at Three Mile Island.

No answers have been received to the consultant technical questions (see Appendix A) provided to DOE officials and to an IAEA representative in June. Little has been done in response to consultant recommendations in July that the U.S. initiate its own study to answer these and other questions on Chernobyl.

Individuals who have performed some Chernobyl analyses report that there has not yet been a successful U.S. calculation of the void dependence of the void coefficient of reactivity reported by the Soviets [4], although it is thought that the Chernobyl calculation may be correct. The Chernobyl incident provides an opportunity to verify U.S. calculational techniques. The little progress points out that too little U.S. effort has been applied to diagnosing Chernobyl.

Better understanding of the Chernobyl design and its accident, calculation of reactivity changes from steam formation, calculation of control worth and spatial power instabilities, mechanisms of pressure-tube failure, propagation of pressure-tube transients and failures to adjacent pressure tubes, transient heat transfer to and from graphite during a severe accident, and interaction of steam with zircaloy and graphite, is essential to our learning the technical lessons from Chernobyl and applying them to U.S. reactors. A DOE-sponsored program to do such analyses is again recommended.

5. LESSONS LEARNED FROM CHERNOBYL

We learn from the reactor accident at Chernobyl, and from the earlier accident at Three Mile Island, that:

1. Relying on a specified design-basis hypothetical accident to assure safety is insufficient. The unanalyzed accidents can happen, from design or operator error or both, a lesson learned earlier at Three Mile Island.

2. Accident analysis should include accidents involving operator error and accidents involving severe core damage.

3. Adequate confinement or containment is needed to protect the public from radioactivity released in a serious accident.

4. Containments and confinements need to be protected against hydrogen explosion or detonation.

5. Good safety practices, implemented by operators and plant management, and subjected to independent audit, are necessary to avoid complacency, to ensure that accidents are prevented and mitigated, and to reduce the likelihood that the unplanned-for accidents will happen.

6. THE N-REACTOR CONFINEMENT SYSTEM

6.1 Functions and Issues

The function of the N confinement system is to prevent radioactivity from escaping to the surroundings. The confinement system consists of the reactor building and coupled auxiliary buildings and compartments that are protected against appreciable internal pressures by quenching and venting the steam expected to be released in the early stages of a severe accident. The design depends on a time delay between steam release and the later release of radioactivity. After the vents close, most of the radioactivity released from a severe core accident is expected to be removed by the fog spray system and filters. Some contaminated air can reach the atmosphere by building leakage.

There is no fundamental reason why a vented confinement system cannot be designed and operated to the same degree of protection and reliability as the nonvented containments of the U.S. commercial reactors. However, Chernobyl, TMI, and commercial reactor containment criteria focus on the adequacy of the N-reactor confinement design. Issues considered here are the possibility that hydrogen generated during an accident will explode and destroy the confinement structure, the adequacy of the design for radioactivity removal, the potential danger from storing accident-generated radioactive liquids in a crib outside the confinement, and the adequacy of the information available to train operators in emergency procedures to protect the N confinement. The ability of the confinement to function depends in part on the time interval between the vented steam release in an accident and the release of hydrogen and radioactivity; it also depends on the amount and rate of release of hydrogen and the amount, rate, and chemical and particulate forms of the released radioactivity.

6.2. N-Reactor Source Terms

The hypothetical accident that is the design basis for the N confinement assumes the rupture of a single Zircaloy pressure tube, automatic shut down of the reactor, and failure of the emergency cooling system to operate. After the rapid initial depressurization by steam and water escaping to the confinement, the fuel heats up more slowly than would occur in a commercial light-water reactor or in a Chernobyl-type reactor undergoing a similar transient, because of the high thermal conductivity and low stored energy of the N-reactor metallic uranium fuel and heat transfer from the hot fuel through the pressure tube into the graphite. Even though the thermal-diffusion time constant for heat to transfer to the graphite cooling system is estimated to be as long as 18 minutes, the transient proceeds slowly enough that the graphite cooling system aids in limiting the temperature rise to about 1200°C, and it provides a long-term heat-removal system that prevents further heating of the reactor core. The calculated temperature rise is also limited by the N designer's belief that hot uranium in the central fuel cylinder will expand to contact the outer tube, so that it is cooled by conduction and blocks the flow of steam that would otherwise react and generate hydrogen and heat in this central region. The maximum fuel temperature of 1200°C is predicted to occur several minutes after the beginning of the accident. About a third of the uranium-metal fuel is predicted to melt, but the Zircaloy cladding and and all other Zircaloy pressure tubes are predicted to remain intact.

In this hypothetical accident the Zircaloy fuel cladding never reaches the threshold level of about 1500°C wherein the steam-water reaction would be so rapid that heat generated by the chemical reaction results in autocatalytic heating and temperature rise, accompanied by near complete reaction of zirconium with any steam that reaches the hot fuel. Such high temperatures and large hydrogen releases are predicted for water-cooled uranium-dioxide-fueled reactors with loss of coolant and no emergency cooling, as occurred in the accidents at Three Mile Island and Chernobyl. Because of the limited temperature rise predicted for the N reactor, the calculated hydrogen generation is low, only about 850 cubic meters, about 0.5 percent of the potential hydrogen generation for this reactor. This compares with about 5500 cubic meters estimated to have been generated in the Three-Mile Island accident, about 50 percent of the potential hydrogen generation for that reactor.

The NUSAR calculations are competently done, but the calculated maximum temperature is close to the threshold temperature for autocatalytic zirconium-water reaction, thereby questioning the assumption that this hypothetical accident is a suitably severe accident scenario to serve as a basis for confinement design. There should be careful scrutiny of the assumptions that are inherent to the NUSAR hypothetical accident, such as no more than one failed pressure tube, no propagation of pressure-tube failure to adjacent pressure tubes, good heat conduction from the central fuel cylinder, and no flow of steam oxidant to the inner surfaces of the fuel. Thus, pressure tube integrity, a problem that is being addressed at the N reactor, becomes of paramount importance in severe accident analysis. The possibility of less efficient cooling of the inner fuel surfaces and intermittent flow of water oxidant to the hotter inner fuel surfaces should be considered, as well as improper operator response that could introduce water into overheated fuel channels. If higher temperatures and more rapid heating transients can occur, cooling by heat conduction to the surrounding graphite and to the graphite coolant will be less effective in limiting the maximum temperatures and fuel damage in the severe accidents.

6.3. Hydrogen Generation and Mitigation

The N safety analysis report [2] and the Design Review Team [5] conclude that hydrogen released to the N confinement building during the hypothetical accident, the most severe accident considered, will not be an explosion hazard because the hydrogen will be well mixed with all air in the interconnected confinement compartments and will not reach explosive concentrations. However, hydrogen generated in a severe accident is expected to be released at high concentrations. At some locations in the confinement volume hydrogen concentrations that can support deflagration or detonation must be expected. Even if the hydrogen were highly diluted by unreacted steam in the reactor, condensation of steam by the fog spray and inleakage of air can result in the formation of deflagratable and detonable concentrations of hydrogen. The issue is what transient concentrations of hydrogen can be reached in what volume of gas, and what damage can result from the combustion of this hydrogen.

Contrasted to the large containment volumes of most commercial pressurized-water reactors, the N-reactor confinement could not survive the pressure increase if an appreciable quantity of hydrogen were to explode, i.e., deflagrate or detonate. The exhaust filters are specially vulnerable. Therefore, the N safety managers must demonstrate that the rapid mixing assumed in the NUSAR actually occurs without local explosion or detonation. The unfounded NUSAR assumption of rapid and complete mixing without explosion or detonation means that the risk from operating the N-reactor can be greater than concluded in the NUSAR analysis. The uncertainties in the containment hydrogen issues are unacceptable and should be resolved with highest priority. There is no reason to wait for the completion of the probabilistic risk assessment, about a year away, to resolve the hydrogen issues. The issues are well defined and can be—and should be—addressed directly and expeditiously.

The N-reactor operator, UNC Nuclear Industries, has recognized the importance of the hydrogen issue and has already commissioned contractor studies to calculate transient concentrations of hydrogen in the confinement compartments, to determine if explosive or detonable concentrations could occur. Results recently obtained from a "lumped-parameter" calculation, that assigns subcompartments and assumes instantaneous and complete mixing in each subcompartment, predict temporal concentrations greater than that calculated in NUSAR. No explosive concentration is predicted when the hydrogen is assumed to be released from a break in the pipe gallery [6]. A deflagration concentration is predicted when the release is in the reactor building, but no damage is predicted, evidently a result of the limited volume of exploding gas. Other locations of the pipe break can give different results and need to be examined, such as the penthouse located above the spray nozzles.

Even when lumped-parameter calculations predict no hydrogen burning, there remains the possibility of damaging deflagrations or detonations within the compartment in which the hydrogen is released. There is DOE capability [7,8] to make the more detailed field calculation that does not rely on the assumptions of instantaneous mixing in compartments that are necessary for the lumped-parameter calculations. It was the expectation that such calculation needed to be done and could be completed during the tenure of the consultants that was one motivation for the consultants' written [9] and oral recommendations to DOE in July that high priority be given to resolving the N-reactor hydrogen issues and other confinement issues. However, the field calculation that could answer the question of hydrogen burning has not yet been authorized.

Whether hydrogen can reach concentrations sufficient to explode and destroy the N-reactor confinement depends also on the amount and rate of hydrogen generation. The NUSAR analysis of the hypothetical accident predicts only about 850 cubic meters of hydrogen from zirconium-water reactions, about 0.5 percent of the potential amount that could be formed if all of the zirconium and uranium were to react with water or steam. In comparison, about 50 percent of the zirconium reacted to form hydrogen at Three Mile Island, and containments of commercial reactors are required to be protected against the release of 75 percent of the hydrogen that could potentially be formed. Further, the amount of hydrogen that could potentially be formed in the N reactor is greater than that at Chernobyl, over threefold greater than in a commercial boiling-water reactor, and about sixteenfold greater than in a commercial pressurized-water reactor. These comparisons are shown in Table 1.

At some amount and rate of hydrogen generation, only about fourfold greater than predicted in the NUSAR accident, deflagratable concentrations of hydrogen in the N confinement would occur even if the hydrogen were instantaneously well mixed with all of the confinement air. Even greater quantities of hydrogen can be produced in the more severe accidents that should be considered.

The NRC requirement that commercial plants protect against 75 percent of the potential hydrogen is not a result of accident analysis. It is a nonmechanistic criterion, similar to the nonmechanistic 10 CFR 100 requirements that commercial containments protect against the release of all of the noble radioactive gases, 50 percent of the radioiodine, etc. The 10 CFR 100 criterion has already been adopted in the NUSAR analysis. The NRC's new hydrogen-protection requirement illustrates the evolution of tighter standards for commercial reactor safety. Another example is the NRC requirement for analyzing more severe reactor accidents than considered in earlier safety analyses. If the N reactor is found wanting under these new standards of commercial reactor safety, it does not mean that N is necessarily of greater risk than earlier perceived. It only means that N has not kept pace with the commercial safety requirements. The Department of Energy should determine to what extent these new commercial-reactor safety requirements should be required for the N reactor.

Containment buildings for some commercial reactors could not withstand

Table 1. Amount of Hydrogen from Metal-Water Reactions

	N Reactor	Chernobyl	Commercial pressurized water reactor	Commercial boiling water reactor
Amount of zirconium				
Fuel cladding, kg	14,800	74,000	21,000	32,600
Pressure tubes, kg	178,000	103,000	0	60,500[a]
Total	192,800	177,000	21,000	93,100
Amount of uranium metal, kg	365,000	0	0	0
Potential amount of hydrogen, cubic meters[b]				
From zirconium	102,000	93,500	11,100	49,200
From uranium	74,000	0	0	0
Total, m^3	176,000	93,500	11,100	49,000
Hydrogen released in accident				
Amount, m^3	850[c]	unknown	~5,500 (TMI)[d] 8,300 (NRC)[e]	36,900 (NRC)[e]
Fraction of potential	0.0048[c]	unknown	~ 0.5 (TMI) 0.75 (NRC)	0.75 (NRC)

[a] In fuel channels

[b] Cubic meters at 0°C and 1 atm

[c] N-reactor hypothetical accident

[d] Estimate for accident at Three Mile Island

[e] NRC criterion for commercial-reactor containment

explosion of the assumed release of 75 percent of the potential hydrogen. They are protected by inerting the containment compartments or by burning the hydrogen soon after it is released. Such mitigation techniques should be considered and evaluated for the N reactor. Present information is not sufficient to determine what hydrogen mitigation technique will be feasible and practicable.

6.4. Removal of Radioactivity Released to the Confinement

Fog sprays in most of the N-reactor confinement compartments turn on automatically if steam is released to the confinement. The water sprays cool and condense steam released early in the accident. The sprays are designed to absorb radioiodine gas and radioactive particulates released from overheated fuel in a severe accident, expected to be released to the confinement after the vent valves have closed. The sprays are predicted to absorb, wash out, and retain over 98 percent of the fission products released to the confinement. There has been no functional test of the ability of the fog sprays to quench steam and remove radioactivity. Assurance of performance rests entirely on the design analysis.

The only documented design analysis of the N spray system is that contained in the 1978 safety analysis report [2,10]. The design assumed rapid and complete mixing of spray droplets with the gas phase in each compartment, it uses mathematical equations derived for heat and mass transfer to single droplets, and it relies on empirical rate coefficients determined in a single-compartment spray experiment [11] wherein steam, aerosols, and iodine vapor were introduced simultaneously and complete mixing was assumed in deducing rate coefficients.

There are several reasons why the N-reactor confinement sprays may not perform in the way predicted by the NUSAR analysis. The processes of heat and mass transport in a practical spray system are not likely to obey the complete-mixing equations assumed for this design. Experience in the chemical industry shows that the movement of both spray droplets and the adjacent gas phase in a spray system is complex. Single-drop correlations, as relied on in the N spray design, are of limited use in the design of a multiple-drop spray systems [12]. Shortly after spray droplets are formed they move countercurrently to the gas, but after some fall distance they move concurrently with entrained gas. Typically, most of the mass and heat transfer occurs within the first few feet from the spray nozzles, rather than being distributed uniformly throughout the compartment as assumed in the N design. Spray heads located at various heights in the compartments, as well as covering all of the compartment cross section, would be necessary to achieve the equivalent of complete mixing. Impingement of droplets on walls also affects the extent of mass and heat transport to spray droplets throughout a compartment. Thus, a spray system is simple to construct but complex to analyze. Because of the uncertainty in scaling to other geometries, the chemical industry has generally avoided spray systems and has favored gas-liquid absorption systems that are more predictable.

Although the N design relies on experimental data taken for the same spray-nozzle height as the design, the cross sectional area of the experiment is not the same as in all of the N compartments. Wall effects on mass and heat transport to the spray can be different than implied in the empirical rate constants determined for different lateral dimensions.

The N design assumes that the bulk of the radioiodine entering the confinement is in the form of elemental iodine, and empirical constants obtained for elemental iodine are used in the design analysis of spray removal. The N designers incorrectly interpret early experiments on release of radioactivity from molten uranium in contact with steam at temperatures up to about 1200°C as demonstrating that elemental iodine is evolved. The reference supplied for this review [13] shows that in the absence of oxygen the predominant form of iodine is hydrogen iodide, which will have spray-removal properties different from those of elemental iodine. Oxygen is not expected to present in the reactor during a severe accident, so elemental iodine assumed in the N safety analysis is not expected. Whether hydrogen iodide decomposes to elemental iodine in the confinement and the effect of hydrogen iodide on spray removal have not been analyzed.

For the more severe accidents that should be analyzed for the N reactor, higher fuel temperatures and the presence of hydrogen from metal-water reactions are predicted [14] to result in the release of radioiodine predominantly as a cesium-iodide aerosol, a subject of intense study by the commercial nuclear industry and the Nuclear Regulatory Commission since the accident at Three Mile Island. This would shift the burden of the fog sprays to removing particulate radioiodine.

The N design analysis for removal of particulates assumes that the particle size distribution released to the confinement in an accident is the same as the particle size distribution used in the spray-removal experiment. Removal efficiency is sensitive to particle size. No information has been provided that justifies the design assumption.

The experimental rate data for spray removal of particulates were obtained when steam and particulates were simultaneously injected into a vessel with sprays. Such particles in a saturated steam-air atmosphere absorb water and grow, thereby making it easier for them to be removed. Empirical rate data obtained in this experiment can predict an unrealistically rapid removal rate in the N confinement, wherein particulate radioactivity is expected to be injected well after the steam is released from a pipe break.

The N design analysis calculates the flow of the gas phase from one compartment to another and assumes that radioactive aerosols entering the downstream compartments are of the same size distribution as those assumed to be injected initially into the confinement. Because larger particles are removed more easily by the sprays, subsequent compartments would be expected to receive the particles that are more difficult to remove, so the N design analysis again seems unrealistic.

To verify the design technique and computer code used to predict radioactivity removal by the sprays, the code was used to calculate the results of the single-vessel experiment that provided the empirical data for the design. There is an unexplained discrepancy in the results, and no other tests and checks are described. This is inadequate verification and validation for a design technique important to nuclear safety.

These questions of the design basis for the N spray system were posed to the DOE staff, to the N-reactor staff, and to the Design Review Team early in this investigation. The Design Review team [5] indicates that the adequacy of the N-reactor spray design has been confirmed by other calculations. However, the calculations supplied assume, with no justification provided, complete mixing and single-drop correlations. There is no indication that any of these correlations has been tested against the extensive data in the chemical engineering literature. *It is recommended that the design analysis of the N-reactor fog spray system, including any new computer codes that are proposed, be reviewed by the group in the Engineering Services Division, Engineering Department of E. I. du Pont de Nemours, at Newark, Delaware, that is expert on mass transfer in practical industrial systems.* Access to this expertise may be possible through the Savannah River Laboratory.

6.5. Confinement of Radioactive Liquid Discharge

Radioactivity removed by the confinement spray system does not remain within the confinement compartments; the radioactive liquid is pumped to an external unlined crib in the ground, at an elevation above the Columbia River. The N safety analysis considers the possibility of volatile radionuclides escaping from this liquid to air, but no analysis has been presented of the possible contamination of ground water and surface water. By exposing this highly radioactive liquid to the environment, the N reactor is no longer confined in the event of a severe accident. *Installation of a closed vessel or tank to contain this liquid is recommended. Similar consideration should be given to containing or purifying the radioactive liquids that are normal bleed and leakage from the primary coolant system,* though these liquid wastes contain far less radioactivity than is predicted to be present in the confinement spray discharge during an accident.

6.6. Confinement Emergency Procedures

Although the N-confinement system is expected to function automatically, there are times when operator action can be required. If block valves that are closed during periodic calibration tests are not reopened, the sprays will not turn on unless operators recognize the symptoms and open the valves. If a pipe break occurs in one of the steam-generator compartments, operators must read the symptoms and turn the sprays on in that compartment. There are safety procedures to train operators to responding to symptoms expected from the accidents considered in the N-reactor safety analysis. The adequacy of these predicted symptoms is questioned by the uncertainties in the N safety analysis, as discussed above. The emergency procedures should be extended to include the possible symptoms that can appear in the more severe accidents that are recommended for analysis. Possible errors by operators in responding to such symptoms should be considered in the accident analysis.

7. PRESSURE TUBES

The Zircaloy pressure tubes in the reactor are being embrittled by neutron irradiation and hydrogen absorption. The allowable limit on fracture toughness will be reached in about five years. Because pressure-tube integrity is of crucial importance to safety, the effect of embrittlement on pressure tube failure and accident initiation needs careful attention. The program of cold hydro testing is an effective means of monitoring pressure tube integrity.

The N accident analysis assumes guillotine breaks in a pressure tube. Longitudinal splits that have occurred in Canadian pressure tubes can give rise to more severe accident conditions and should be considered in the analysis of severe accidents.

8. ON-LINE SAMPLING OF PRIMARY COOLANT WATER

When constructed, the N reactor had an on-line sampling system to monitor the chemical conditions of the primary water coolant. The system is no longer operable, a result of inadequate maintenance. Water samples are obtained and analyzed manually in a contaminated laboratory wherein operators must wear full protective clothing. Temperature and pressure control equipment for nonradioactive samples is in disrepair. Water chemistry limits are exceeded frequently, resulting in accelerated corrosion and increased personnel exposures. On-line sampling should be restored.

9. PROBABILISTIC RISK ASSESSMENT

A full probabilistic risk assessment of the N reactor is needed, to ensure that the N operators and safety management focus comprehensively on the malfunctions, possible failures of equipment and operators, and sequences of events that could give rise to probable low-consequence accidents and to the severe core-damage accidents that will challenge the containment. A thorough and concentrated analysis, involving the N safety managers and designers as well as independent outside groups, would be preferable to the two parallel assessments now underway.

The earliest date now estimated for completing the probabilistic risk assessment is about one year from now. The probabilistic risk assessment is important, but it should not interfere with the more immediate attention that must be given to the issues outlined above.

10. THE MANAGEMENT OF NUCLEAR SAFETY

Complacency by operators, managers, and infrastructure, engendered by many years of successful operation and by the belief that the unexpected cannot happen, appears to have been a root cause of the Chernobyl accident, it was a major contributor to the Three Mile Island accident, and it is a central issue in the management of nuclear safety at any reactor. Complacency is now challenged at commercial reactors by the Nuclear Regulatory Commission's Licensing Event Reports; the Institute of Nuclear Power Operation's (INPO's) systematic and frequent communication of operating experiences at other reactors; implementation of INPO's standards of good practice; INPO's audits of review and audits of training, operations, emergency response, and management; and by the periodic inspections by the Nuclear Regulatory Commission.

The N reactor is operated by a competent organization and is monitored by competent groups within the Department of Energy. However, the N reactor suffers from being a one-of-a-kind reactor, without the direct benefits of maturing and evolving safety technology and practices that accompany the multiple and continuing analyses and review of the commercial reactors. The N safety infrastructure does not provide the extensive technical communication on safety issues that results from NRC- and INPO-stimulated communication on safety issues and operating experiences from commercial reactors. The N-reactor design is unique, but the practices of operation and management essential to ensure nuclear safety are not. Safety management of the N reactor would benefit greatly by full participation with INPO and its commercial and foreign members.

INPO audits are conducted by experienced teams expert in the practices of managing nuclear safety, expert in making effective audits, and up to date on the experiences and technical problems at other plants. The automated SEE-IN information exchange and communications managed by INPO is used by all commercial reactor operators in this country and by many foreign countries. INPO audits of all phases of N-reactor operation and safety management, accreditation of N-reactor training by the National Academy for Nuclear Training, and participation in the INPO communications system by the N-reactor operators and management are recommended.

11. FINDINGS

Based on the analysis and discussion presented in this report, the following findings are reached:

1. Have all key technical questions and potential safety issues been

considered?

Technical questions and potential safety issues have been considered comprehensively by the UNC Nuclear Industries and by the Department of Energy's safety review teams. Further investigation needs to be carried out in several areas, as outlined herein, as well as in areas identified in the reports from the review teams.

2. Have relevant facts and findings from the Soviet accident been addressed by the review teams?

The Department of Energy review teams have addressed comprehensively the relevant facts and findings of the Chernobyl accident that are now available. The analysis presented in this report questions some of the N-reactor conclusions and recommendations by the review teams and it calls for higher priority and more immediate action on confinement issues.

3. Is the N reactor being operated safely?

The N reactor is being operated competently and with good safety practices, although some, such as the maintenance of the on-line sampling system, do not measure up to the practices now set for the commercial reactor industry. The N reactor does not now operate within the risk level concluded in the 1978 safety study because of:

1. technical uncertainty in the production of hydrogen in severe accidents,

2. doubt that the hydrogen will be so rapidly mixed within the confinement compartments that hydrogen burning cannot occur,

3. the need to install ignitors or to inert the confinement to prevent hydrogen explosion,

4. technical uncertainties in the design of the confinement fog sprays to remove radioactivity released to the confinement, and

5. risk of contaminating ground and surface water from radioactive liquids produced in a severe accident and pumped to a crib outside the confinement.

The N reactor has not kept pace with some of the evolving safety requirements and practices of the commercial reactor industry, and it does not operate within the risk level implied by those requirements.

The Department of Energy should determine what N-reactor safety standards and risks are justified by the benefits from its operation.

4. Can the N reactor be operated safely?

The N reactor can be operated within the risk levels found in the 1978 safety analysis report if the uncertainties in that report, as identified herein, are resolved. The report concludes that hydrogen will not burn in the confinement and that the fog spray will quench the steam and remove radioactivity released to the confinement. An adequate technical basis for that conclusion has not been established for the N reactor.

The N reactor can be operated within the safety standards of the commercial reactor industry, but it will require considerable extensions of the safety analysis, modifications to plant and procedures, and participation in the communication and audit process of the commercial reactor industry.

The Department of Energy should determine if the tighter safety standards of the commercial reactor industry are justified for the N reactor.

12. RECOMMENDATIONS

Based on these lessons and on the evaluation discussed later in this report, the following principal recommendations are made:

1. The Department of Energy should determine the standards for risk and safety for the N reactor that are justified by the benefits from operating that reactor.

2. Resolve the uncertainties in performacce of the N-reactor confinement system.

3. Install a hydrogen-mitigation system for the N-reactor confinement. Calculate the local concentrations of hydrogen in confinement compartments during an accident, including the effects of larger amounts and rates of hydrogen release and including different locations of the release, to aid in designing the hydrogen-mitigation system.

4. Install a confined basin or tank to contain highly radioactive liquids that will be pumped from the confinement during an accident.

5. Update the safety analysis of the chemical form and amounts of fission products that will be evolved from overheated fuel.

6. Extend the safety analyses to include accidents that can develop higher fuel temperatures, generate greater quantities of hydrogen at greater rates, and evolve fission products in different chemical forms, including accidents involving equipment failure and operator error.

7. Analyze the performance of the radioactivity removal system in the N confinement, to include:

(a) the different chemical and physical forms of radioactivity that can be released to the confinement under accident conditions,
(b) a technical basis for the particle-size distribution of particulate radioactivity released to the confinement and transported to other compartments,
(d) a mass transfer analysis that does not rely on data on radioactivity-removal kinetics obtained when there is simultaneous condensation of steam, and
(e) an analytical technique that has been verified and validated, including verification with data on multicompartment removal systems and validation of assumptions of gas and liquid flow and mass-transfer kinetics.

8. Develop realistic predictions of confinement performance symptoms, e.g., time-dependent pressure, temperature, species and radioactivity concentrations to be used in training confinement operators and in developing emergency procedures to mitigate possible confinement malfunctions during accidents.

9. The N-reactor operating organization should become an active information-sharing participant with the Institute of Nuclear Power Operations (INPO), should implement the safety management practices established for the commercial reactor industry, should be audited periodically by INPO, and should have its training program accredited by the National Academy of Nuclear Training.

The above recommendations should be implemented in the near future and should not wait the completion of the probabilistic risk assessments of the N reactor that will take at least a year.

10. The Department of Energy should sponsor thorough technical analyses to better understand the details of the reactor transients involved in the Chernobyl accident and to verify the ability to calculate such transients.

13. ACKNOWLEDGMENTS

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14. United States Nuclear Regulatory Commission, "Technical Bases for Estimating Fission Product Behavior During LWR Accidents," Report NUREG-0772, June 1981.

APPENDIX A.

Questions to the U.S. Department of Energy on the Chernobyl Accident
June 18, 1986

1. What event(s) caused the transient from 7 to 50 percent power, and what events caused release of hydrogen and fission products?

2. Is it correct that there was no loss of offsite power?

3. If a single pressure-tube channel is completely voided, is the net reactivity change from a water-filled channel or a channel in normal operating conditions positive or negative?

4. Can loss of coolant to one process tube cause reactivity changes or flow changes that result in loss of coolant to an adjacent process tube?

5. Soviet technical reports describe concrete-walled rooms near the reactor that contain the header and steam separator, to which the process tubes or connected. The room is designed to contain an overpressure of about 27 psi. Does this 27-psi envelope extend under the working floor that is immediately above the reactor?

6. Are the cavities designed for 27 psi and others for 52 psi lined with metal or with other material to result in a low leak rate of gases from the cavities?

7. Are noncondensable gases that evolve from the pressure-suppression pools contained in the suppression-pool cavities? If not, where do they vent?

8. What is the design pressure of the pressure-suppression pool cavities?

9. What gas normally exists between the top of the reactor and the bottom of the working floor above the reactor?

10. Is the reactor designed to withstand the failure of a pressure tube, thereby allowing water and steam to discharge directly into the surrounding graphite?

11. Had any provision been made for handling hydrogen generated by zirconium-water reaction?

12. Was spatial instability of neutron flux involved in this accident sequence? If so, was it axial instability or azimuthal instability?

13. What are the failure pressures of the compartments described above?

APPENDIX B

Comparison of RBMK-1000 (Chernobyl Unit 4) and N Reactor Design

(Supplied by the Pacific Northwest Laboratory)

Design Characteristics	RBMK-1000	N Reactor	Remarks
Reactor type	Vertical pressure tube-boiling water-graphite moderated	Horizontal pressure tube-pressurized water-graphite moderated	The vertical arrangement, boiling water concept is a basic contrast to the horizontal arrangement pressurized water concept
Refueling	On-line	During shut-down	
Design power generation - MWt	3140	4000	The on-line refueling is inherently a higher risk operation than refueling while not operating.
Electrical Power generation-MWe	1000	860	
Inlet temperature (avg.)	270°C (518°F)	400°F	
Outlet temperature (avg.)	284°C (543°F)	543°F	
Operating pressure (outlet)	70.21 kg/cm^2 (1000 psi)	1600 psi	
Total reactor coolant flowrate	42,000 t/h (76.2x10^6 lb/h)	83.2 x 10^6 lb/h	

Comparison of RBMK-1000 (Chernobyl Unit 4) and N Reactor Design

Core Description	RBMK-1000	N Reactor	Remarks
Core dimensions (active zone):			
Height	7.0 m (275.6 in.)	302 in.	The RBMK has a positive void coefficient in contrast to a negative void coefficient at N reactor
Diameter or width	11.8 m (464.6 in.) Dia.	303 in. width	
Length		418 in.	
Volume	765.5 m^3 (46.71x$10^6$$in^3$)	38.25 x 10^6 in^3	
Total number of fuel channels	1661	1003	
Lattice spacing	250 mm x 250 mm (9.8 in. x 9.8 in.)	9 in. vertical x 8 in. horizontal	
Moderator material	Graphite	Graphite	
Operating temperature (maximum)	750°C	600°C	
Material density (theoretical)	1.67-1.73 g/cm^3	1.71 g/cm^3	
Material density (as stacked)	1.31-1.36 g/cm^3	1.29 g/cm^3	
Moderator weight	976 mt (1.076 t)	900 t	
Reflector Dimensions:			
top and bottom	500 mm (19.69 in.)	48 in.	
sides	1000 mm (39.37 in.)	44 in.	
front and rear		20 in.	

Comparison of RBMK-1000 (Chernobyl Unit 4) and N Reactor Design

Fuel	RBMK-1000	N Reactor	Remarks
Design	Two 18 rod elements connected in series	Multiple uranium tube-in-tube	
Uranium form	UO_2	Metallic	
Cladding material	Zr-1% Nb	Zr-2	
Enrichment wt% ^{235}U	2.0	0.71-1.25	This combined with the greater graphite temperature and steam water coolant state of the RBMK increases the risk further
Fuel assembly length	7.0 m (22.95 ft.)	34.8 ft.	
Maximum clad temperature	323°C (613°F)	583°F	
Maximum fuel temperature	1,800°C (3272°F)	807°F	
Total fuel weight	186 mt	366 mt	
Fuel exposure	18.5-22.3 GWd/t (18,400-22,300 MWD/MTU)	440-1980 MWD/MTU	
Maximum Thermal Flux	83 W/cm^2 (263,325 BTU/hr-ft^2)	385,660 BTU/hr-ft^2	

Comparison of RBMK-1000 (Chernobyl Unit 4) and N Reactor Design

Fuel Channel	RBMK-1000	N Reactor	Remarks
Number	1661	1003	To provide the 14.5% average steam quality the flow to the individual fuel channels of the RBMK-1000 are manually reset 2 or 3 times during the fuel cycle. The N reactor allows no flow adjustments
Pressure tube diameter (OD)	8.8 cm (3.46 in.)	3.26 in.	
Pressure tube wall thickness	0.4 cm(0.158 in.)	0.275 in.	
Material	Zr-2.5% Nb	Zr-2	
Termination method	Diffusion welded Zr to SS joint in reactor core zone	Rolled Zr to CS joint out of reactor	
Individual channel flow control	Manually adjusted regulating valve	Orifice installation at outer fringe tubes	
Inlet temperature	270°C (518°F)	400°F	
Outlet temperature (avg)	284°C (543°F)	543°F	
Quality	14.5% avg. steam	subcooled	
Average tube power	1890 KWt	4000 KWt	
Average tube flow rate	45.01×10^3 lb/h	83.35×10^3 lb/h	
Axial peak/avg. power ratio	1.26-1.33	1.40	
Radial peak/avg. power ratio	1.27-1.40	1.25	

Comparison of RBMK-1000 (Chernobyl Unit 4) and N Reactor Design

Control-Shutdown System	RBMK-1000	N Reactor	Remarks
Type	Boron steel segments encased in aluminum, lowered by gravity and retreived by servo-mechanisms from above through a cable.	Boron carbide encased in titanium, driven by pressurized accumulators horizontally into the reactor.	The N Reactor control-safety rods are fully inserted in 1/8 the time required for the RBMK rods. The horizontal arrangement, in contrast to the vertical arrangement, is not prone to be ejected during an accident or drive failure
Number of control-shutdown assemblies	211	84	
Neutron absorption material	Boron steel	Boron in B_4C	
Control rod spacing	500 mm x 500 mm (19.7 in. x 19.7 in.)	32 in. horiz. 36 in. vert.	
Control rod travel	6.25 m (20.5 ft.) except auto. control rod - 4.5 m (14.8 ft.) & axial control rod - 7.0 m (23 ft.)	29.5 ft.	
Cooling method	Separate water cooling system with downward flow in individual channels	Integral water cooling jackets	
Drive	Gravity	Hydraulic (with accumulators)	
Control rod full insertion time	20 seconds	2.5 seconds	

Comparison of RBMK-1000 (Chernobyl Unit 4) and N Reactor Design

Safety shutdown system	RBMK-1000	N Reactor	Remarks
Type	Same as control-shutdown rod assemblies	Boron in boron oxide balls contained in hoppers above individual moderator channels. Release is spring loaded and held by electromagnetics system in a "fail safe" manner	The N reactor safety shutdown system is based on a different principle and is independent of the control-shutdown system
Number of safety shutdown assemblies	21	107	
Neutron absorption material	Boron steel	Boron in B_4C	
Drive	Gravity	Gravity	
Minimum shutdown margin		19.0-20.9 mk (1.0 mk margin with failure of 5 strongest ball hoppers)	

Comparison of RBMK-1000 (Chernobyl Unit 4) and N Reactor Design

Primary Water Recirculation	RBMK-1000	N Reactor	Remarks
System material	Austenitic stainless steel	Carbon steel	The 2 independent primary loops and in-reactor boiling of the RBMK-1000 reactor coolant provides a more difficult nuclear control problem than the N reactor single loop pressurized water concept
Total flow rate	42,000 t/h (76.2 x 10^6 lb/h	83.2 x 10^6 lb/h	
Equipment cells	2	6	
Independent flow loops	2	1	
Steam separators (total/per loop)	4/2	none	
Steam heat exchangers (total/normally operating)	none	12/10	
Pumps (total/normally operating)	8/6	6/5	
Pump dynamic head	2.0 MPa (669 ft, H_2O)	804 ft, H_2O	
Dimensions of individual inlet piping (OD x wall)	5.7 x 0.35 cm (2.244 in. x .158 in.)	2.625 in. x 0.260 in.	
Dimensions of individual outlet piping (OD x wall)	7.6 x 0.4 cm (2.992 in. x .158 in.)	2.625 in. x 0.260 in.	

Comparison of RBMK-1000 (Chernobyl Unit 4) and N Reactor Design

Steam Secondary System	RBMK-1000	N Reactor	Remarks
Steam collector type	Primary system steam separators	Tube type heat exchangers	The N reactor steam generators provide a pressure-retaining barrier between the reactor primary coolant and the secondary steam. The RBMK-1000 boils the primary coolant in the reactor and uses this steam directly for power generation
Number	4/2 (total/per loop)	12/10 (total/ normally operating)	
Collector (ID x Length)	2.6 x 30 m (8.53 x 98.4 ft.)	10 x 57 ft.	
Steam pressure	6.86 MPa (995 psia)	150 psia	
Steam flowrate (total)	5.468 t/h (12 x 10^6 lb/h)	13 x 0^6 lb/h	
Power generation	1000 MWe	860 MWe	
Heat rejection w/o turbogenerators	Water reservoir	16-dump condenser heat exchangers	

Comparison of RBMK-1000 (Chernobyl Unit 4) and N Reactor Design

Release Control	RBMK-1000	N Reactor	Remarks
Type	Partial steam suppression of releases from the reactor cavity, inlet piping and pumps	Confinement system employing initial steam release followed by high efficiency filtration of releases	The RBMK-1000 doesn't have a confinement system. The upper portion of the reactor, outlet piping and steam separators have no substantial enclosure. Steam from the reactor is directed out into the machinery bay which is housed in a standard industrial building
Enclosure	Lower half of reactor and lower half of piping system.	Entire reactor, coolant system and reactor gas system	
Function	Condense steam from piping break or steam separator relief valves.	Confine radionuclides from the reactor and potentially contaminated piping systems.	Off-gases from the steam supression pool below the reactor is released into the upper reactor area when relief valve settings are exceeded.
Design pressure	Enclosure areas designated about 0.4 MPa (58 psi)	+5.0 psig to -2.0 psig.	
Operation	Steam -water from pipe break or steam separator relief valves directed to standing water in bubbler pond below reactor. Water spray above bubbler pond helps condensation process.	Vent valves release initial steam - surge following pipe break. Fog spray system control confinement pressure to near atmospheric. Filter system to remove 99.95% of particulates and 93% elemental radiohalogens.	

MILES C. LEVERETT

October 3, 1986

The Honorable John L. Herrington, Secretary
US Department of Energy
1000 Independence Avenue, S.W.
Washington, DC 20585

Dear Mr. Secretary:

SUBJECT: REVIEW OF N-REACTOR SAFETY

In accordance with a request from your office, I have carried out a review of the safety of the Hanford N-Reactor. In this review I have had the benefit of briefings by various DOE staff members, of briefings by the N-Reactor personnel, by national laboratory personnel, of voluminous written material pertaining to the N-Reactor and to the Chernobyl-4 Russian reactor and others of that type. I have also had exchanges of views with five other consultants similarly appointed by your authority (these are Mr. L. H. Roddis, Professor H. W. Lewis, Professor T. H. Pigford, Dr. G. F. Tape, and Admiral (Ret.) E. P. Wilkinson). I have, of course, also drawn on my own association with the N-Reactor during the years 1962-1967.

I have also had the benefit of reading reports generated by three DOE review committees:

Report of the Special Safety Team Review of N-Reactor (graphite and confinement issues) May 1986

Technical Safety Appraisal of the N-Reactor, June 1986

Design Review of N-Reactor, July 1986

Finally, I have seen the draft of the action plan to address the recommendations appearing in the three reports just mentioned.

From this considerable body of information I have drawn conclusions which are my own. They are expressed in summary in this letter. In some cases, my conclusions are similar to those appearing in the above-mentioned reports. I hope that my including them in this letter will add emphasis.

My overall conclusion is that the N-Reactor is being operated safely.

However, for continued operation I believe that certain improvements are in order to bring the reactor to a level of safety assurance comparable to that required of commercial nuclear power reactors by the Nuclear Regulatory Commission (NRC). These are improvements which are recommended if it is intended to operate the reactor for the next several years. In my opinion, the question of the safety of the reactor in the more distant future is moot, as will be explained below, because I believe that expansion of the graphite stack will make it necessary to remove all or part of it or replace the reactor completely in the next several years.

According to data which have become available in the last several weeks, the graphite stack appears to be expandng vertically at the rate of about 0.8 in. per year. The clearance between the top of the graphite and the lower surface of the thermal shield is now about 2.3 in., suggesting that contact may be expected in about three years. If prompt action is taken to flatten the power in the reactor, and if the reactor power level is lowered, the rate of expansion can be slowed down so as to provide more time, but even with such measures operation beyond the very early 1990s seems unlikely to be feasible without major repairs involving large expenditures and an extended reactor shutdown period. Taking into account the slowness of the budgetary process and other necessary steps, I believe that the time is at hand when it should be decided whether to replace the N-Reactor with another reactor or simply shut it down when the graphite growth reaches its tolerable limit. The plans that I have seen for replacing the graphite seem only marginally feasible, and extension of reactor life beyond that time would also require other fairly expensive and time-consuming actions.

I am making no judgment regarding whether the operation of the N-Reactor should be continued for the short term, or, if it is not continued, whether a replacement for it should be obtained. Such a judgment would involve matters of national security and others which are beyond any special expertise which I may have. I do believe that operation of the reactor beyond the limit imposed by the growth of the graphite stack would require such extensive upgrading and renovation of the whole plant and the reactor itself as to be cost-ineffective in terms of funds and technical talent.

The fact that the end of N-Reactor's productive life is in sight is, however, no reason for not proceeding expeditiously to make the improvements mentioned above, and which I shall briefly describe below. The N-Reactor went through a period in the 1970s during which the uncertainty regarding its continued operation had the unfortunate effect of allowing the reactor's safety aspects to fall behind the various advances made in the safety of commercial reactors and the changes in NRC requirements. That should not be allowed to happen again. In the period since the 1970s the safety of the N-Reactor has been improved in many ways. As a result it is now safer than before. But there are still areas where improvement is needed in the light of present safety thinking and public perceptions. In the following paragraphs I will elaborate some of these thoughts and summarize my recommendations.

In making judgments regarding reactor safety, my main frame of reference is my association over the last three decades with the safety of commercial nuclear power plants. I believe that the commercial plants constitute a suitable yard stick by which to evaluate the safety of military production reactors.

1. Continued N-Reactor Operation is Acceptable for the Next Several Years

The N-Reactor record of 23 years of operation with no events which have adversely affected public or occupational safety is impressive. It is true that there is no assurance that this situation will continue, but with the intensified attention to safety, which I believe it reasonable to anticipate, I have little concern about operation until such time as the graphite expansion forces complete replacement or shutdown of the reactor.

2. Backup Emergency Core Cooling Project Should Be Completed

I distinguish two kinds of safety precautions: those which tend to prevent accidents, and those which tend to mitigate the effects of an accident once it has started. It is clearly more desirable to prevent accidents than to mitigate them, but both types of precautions are necessary.

My assessment is that the N-Reactor is well supplied with preventive measures. Some of them, like the two, diverse, fast acting reactor shutdown systems and the individual tube flow and cladding failure detectors are unique. I do have some concern about one feature of the emergency core cooling system. This system is made up of two separate systems, either of which is capable by itself of cooling the shutdown reactor. Although the arrangement and protective features of these systems meet the main NRC requirements for independence and fire protection, they are relatively close together in some important areas. This closeness leads to some vulnerability to common cause failure.

I understand that a project to provide a third source of supply of water to the emergency core cooling system, entirely separate from the others, is in an early stage. Even though this system would use existing equipment that does not meet current NRC safety requirements, I recommend strongly that this project be completed expeditiously. I think that this action will complete the provision of an array of core damage preventive measures that will be adequate for the next few years. I note that action on a longer term, higher-quality project of this type has been recommended. That would be appropriate if operation beyond the next few years were planned.

3. Hydrogen Igniters Should Be Installed

The most important mitigative measure at the N-Reactor is the confinement system. The confinement principle is sound and is used in assessing the safety of commercial reactors in certain hypothetical reactor accidents. However, the N-Reactor confinement system suffers from a major uncertainty in that it is not clear that it could withstand an internal explosion of the hydrogen which might be generated in the reactor in a severe accident and released to the confiner.

It is believed that at both Three Mile Island Unit 2 (TMI-2) and at Chernobyl-4 there were hydrogen explosions. In neither case was a major hydrogen explosion considered in pre-accident analyses. The TMI-2 explosion was relatively harmless thanks to a strong containment. At Chernobyl-4 it is now believed that the initial explosion was due to a rapid over-pressurization of the process channels but that subsequent hydrogen combustion contributed importantly to the disastrous nature of the accident because no correct assessment of the magnitude of potential accidents had been made and because no proper provision for accommodating such accidents had been made.

Predictions of the quantity of hydrogen which would be expected in a severe accident in the N-Reactor have been made; relatively small quantities have been predicted. These predictions are controversial because they do not appear to account adequately for some more severe hypothetical (but still mechanistic) accidents. Further remarks on the need for more complete accident identification appear in a later portion of this report. For the present, it may be noted that a large hydrogen explosion in one of the many compartments of the N-Reactor confinement would cause serious damage to it and probably would render it functionally ineffective.

My conclusion is that it is important to provide the N-Reactor with a means of preventing hydrogen explosions or of mitigating their effect to such a degree that the confiner will retain its integrity. I believe that the most practical way of doing this is to install a so-called "distributed ignition system" which will, in effect, ignite the hydrogen as it emerges into the confiner. A series of small pressure pulses, well within the pressure capability of the confiner, rather than one or a few large ones would be the result. The heat of combustion would largely be taken up by the confiner walls, or by the fog spray if operating. Such systems are now required by the NRC in commercial reactors having ice condenser or Mark III types of containment. These types of containment have relatively low design pressure capabilities and would probably be severely damaged by the explosion of the accumulated hydrogen from a severe core accident.

Hydrogen ignition systems are also used in certain reactors of the CANDU type.

I recommend strongly that the design and installation of a distributed hydrogen ignition system be undertaken in the N-Reactor.

4. Probabilistic Risk Analysis Should Be Expedited

I understand that two probabilistic risk analyses are under way, one sponsored by the DOE and the other by the N-Reactor contractor. It is unfortunate that it has taken so long to get a PRA started, but it is not clear that two PRAs are necessary. One good one would be enough. For reasons of credibility and comparability with commercial PRAs, it is very desirable that the PRA be done under the guidance of a commercial practitioner. The PRA should be, and I believe is planned to be, a level 3 PRA, that is, it should evaluate public consequences and their probability as well as the probability of a core-damaging accident and confiner loss of integrity.

The value of a PRA lies not only in the fact that it provides an estimate of accident probability and consequences, but also in that it forces the analyst to inquire into the types and probabilities of possible accidents in a systematic, disciplined way. In order to gain the full benefit of a PRA, there must be active involvement in it by the engineers and others who will have a continuing association with the plant and who, in the future, can, with the aid of the PRA, evaluate changes or occurrences which may not have been considered when the PRA was done originally. To turn the doing of a PRA over to a PRA practitioner to be done largely with his own people is to deprive the sponsor of much of the benefit of doing the PRA. The role of the practitioner should be that of supplying specialized codes, advice, and assistance.

In performing the PRA, particular care should be taken to include consideration of accident scenarios like those now considered in NRC severe accident analyses. High-consequence low-probability scenarios such as complete plant black-out (including loss of ECCS diesel-driven pumps) and the introduction of water into the reactor onto hot fuel following an extended loss of coolant have not been considered in the N-Reactor so far. The result is that the consequences of really severe accidents are not included in the NUSAR. Although such accidents should come to light as part of the PRA, there is no reason to defer examining those that can be identified now; they can and should be separately analyzed at once without awaiting the completion of the somewhat slow PRA process.

It is interesting, and it may be significant, that a search of the available Soviet literature discloses little attention on the part of the Soviets to PRA until quite recently.

I strongly recommend that a probabilistic risk assessment on the N-Reactor be completed expeditiously and as indicated above. Selected potential severe accident sequences should be analyzed at once, even though it would be expected that they would also emerge and be analyzed during the PRA.

5. Intensification of Process Tube Monitoring is Endorsed

The Design Review Team recommended intensification of the program of monitoring the condition of the Zircaloy-2 process tubes. I do not expect deterioration of the process tubes to be the life-limiting aspect of the N-Reactor or to become a safety problem. But the progressive embrittlement of the tubes due to fast neutron bombardment and hydrogen absorption will continue as long as the reactor is operated. Because the Zircaloy is tougher and less susceptible to brittle failure at high temperatures than at low temperatures, the most critical condition for tube failure is that of cold hydro-testing. Process tube failure during cold hydro-testing would be a relatively benign accident, since it would be expected to produce no fuel failures. Thus, cold hydro-testing, which is a required routine already, provides an excellent way of detecting excessively embrittled or weak tubes. The process tube monitoring program, in which tubes are removed from the reactor at stated intervals and destructively examined is another excellent way of following the changes in process tube properties, and I support the recommended intensification of that program.

6. Creation of an Alternate Control Room is Supported

It is a standard NRC requirement that it be possible to safely shut the reactor down from a location other than the main control room. There are plans to create an alternate control room in the southern end of Building 109 at the N-Reactor. This will provide assurance that if the main control room is uninhabitable or lost for other reasons, there will still be a chance of putting the reactor into a safe, stable state. Care should be taken that habitability of the alternate control room is not lost due to whatever may have caused the loss of the main control room. With this caution I endorse the plan for creation of an alternate control room.

7. INPO Reviews of N-Reactor Operations Should Be Instituted

The DOE review group which produced the "Technical Safety Appraisal of the N-Reactor," referred to earlier in this report, identified a relatively large number of recommended improvements in a wide variety of areas such as organization, administration, operations, maintenance, training and certification, emergency readiness, technical support, radiological protection, personnel protection, quality assurance, security/safety interface, and fire protection. Although one would expect that, even in a well run organization, an intensive review by a large group of auditors would reveal a fair number of discrepancies of these kinds, the number reported in this case significantly exceeds what would be expected in a commercial nuclear power plant. With few, if any, exceptions, the identified discrepancies are not matters of direct safety concern, but in the aggregate they appear to be significant.

Most of the deficiencies or discrepancies reported are of a type which can be corrected by suitable action on the part of the contractor's manager and his staff. My conclusion is that it would be well for DOE to adopt the commercial practice of periodic review by the Institute of Nuclear Power Operations (INPO). Situations similar to those reported to exist in the N-Reactor have not been uncommon in the commercial nuclear power industry. INPO was created, in part, to provide a within-the-industry means of identifying the best practices, particularly those which are the direct responsibility of management, and to communicate, on a relatively confidential basis, to each plant how its own practices could be improved if necessary. INPO inspections are recurrent and previous recommendations are closely followed up to ascertain what response they have produced.

I recommend that the N-Reactor contractor arrange with INPO for regular reviews similar to those carried out by INPO in commercial plants and that INPO's recommendations be regarded by the N-Reactor contractor and by DOE as having as much force for the N-Reactor as INPO's recommendations for commercial plants have for those plants.

8. A Standing Technical Oversight Group Should Be Created

N-Reactor technical personnel have repeatedly, and over a period of many years, voiced the concern that, because of the unique design and purpose of the reactor, they might become somewhat insulated from events, technology, and concerns arising in commercial reactors. This is a real possibility for which the N-Reactor technical people have partly compensated by making extensive use of the resources of the Pacific Northwest Laboratory and the Hanford Engineering Development Laboratory, and by setting up technical review groups made up of outside experts. What seems to be missing, however, is the kind of review which could come from a group like the Advisory Committee on Reactor Safeguards (ACRS), although I believe that it would be advisable that the group have more intimate contact with the N-Reactor than would be possible for the ACRS. In particular, its contact with the N-Reactor should be close enough that it would be able knowledgeably to take the initiative in deciding what subjects to review, rather than relying on the N-Reactor to designate those subjects for it.

I wish to make it clear that this recommendation is not a criticism of the technical competence or dedication of the N-Reactor technical staff. It is the kind of recommendation which I would make to any technical group, no matter how competent, which had a responsibility like that of the N-Reactor group.

I recommend the formation of a standing technical oversight group for the N-Reactor.

9. DOE and Contractor Safety Responsibilities Should Be Better Defined

The responsibility for the safety of the N-Reactor appears to be shared between the DOE and the contractor. During one of the July presentations by DOE representatives, the question of the partitioning of this responsibility between the two parties was raised. It was surprising that no crisp statement of their respective responsibilities was given. Granting that a question of this importance might need to be answered carefully, the impression remains that there may be some confusion on this point.

During the General Electric Company's period of stewardship of the N-Reactor, it was understood that the contractor was supposed to satisfy himself that the reactor and its operation were safe and met all applicable regulations. The contractor was under no obligation to operate the reactor, if in his judgment, it was unsafe to do so. It was the obligation of the government to provide the funds to build and maintain a reactor which, the contractor agreed, could be operated safely. The government, of course, had similar veto authority over anything which it considered unsafe. In matters of contractor-proposed safety betterment, which were aimed at removing risks that could be tolerated for a short time, and which were in funding competition with other betterments, the government and the contractor agreed on priorities.

I would hope that a similar arrangement still persists, but I have seen no statement to this effect.

On the DOE side, the responsibility for N-Reactor safety does not seem to be clearly assigned below the level of the Secretary himself. Specifically, it is not clear to me what official or officials within DOE have the authority to shutdown the N-Reactor for reasons of safety without recourse to higher authority. It is also not clear where DOE has assigned the responsibility for deciding what safety improvements to fund and on what priority.

I recommend that DOE make a clarifying statement regarding the safety responsibilities of the N-Reactor contractor and of DOE in its various organizational components.

10. Coolant Bleed-Off Discharge to the Ground Should Be Discontinued

Except for liquid pathway discharges, the N-Reactor has little impact on the environment. However, two types of liquid discharges are of concern. One is the normal bleed-off and leakage from the primary coolant loop of about 1100 gpm. The other is the contingent plan to similarly discharge, in a severe accident, the contents of the primary loop which may possibly contain a large quantity of fission products from failed fuel. The former concern will be discussed under this item; the latter under the next one.

In order to maintain the necessary purity of the water in the primary cooling loop, about 1100 gpm of it is bled off or leaks off and is discarded at a nearby percolation site. The discharged water, about 0.7% of the reactor throughput, is allowed to percolate into the soil, and eventually emerges as springs at the edge of the nearby Columbia river. Although fuel failures are infrequent, normally one or two per year, one does occur occasionally with some release of fission products to the reactor coolant. In addition, "tramp" uranium on the fuel or in the process tubes can fission and release fission products to the coolant. The retentive nature of the soil at the N-Reactor is such that, of the released fission products, only radioiodine has been appearing in the riverside springs in quantities which require taking credit for dilution by the river itself to bring the concentration below drinking water limits. Recently, radiostrontium has appeared in the springs. In response to this, a new percolation site, more distant from the river than the old one, is now in use.

At no time has discharge of reactor coolant to the ground been harmful to users of the river, and there is no indication that a harmful condition would arise in the next several years. But this represents an environmentally poor practice.

The obvious corrective measure is the installation of an ion exchange system through which the presently discharged water would be passed and re-used as reactor coolant. This type of reactor coolant purification is used on a much larger scale by commercial nuclear power plants of both PWR and BWR types.

I recommend the installation of a water purification system for the recovery of waste reactor coolant.

11. An Alternate Plan for Handling Accident Waste Water is Needed

In the event of a severe accident at the N-Reactor, it is likely that a considerable volume of highly contaminated water would result from cooling failed fuel. I understand that the contingent plan, in such a case, is that this waste water would be discharged into a pit in the desert in the general vicinity of the reactor. Inevitably this would result in long-lasting contamination of the ground, with a strong likelihood that the river also would become contaminated. I judge that a better plan for handling this waste water must be developed even though there is no expectation of ever having to use it.

At Three Mile Island Unit 2, the contaminated coolant overflowed the quench tank and spilled into the basement of the reactor building where it stayed until, a few years later, it was processed through ion exchange equipment. It appears to me that a similar solution could be devised at N-Reactor, perhaps with some building modifications to assure containment of the waste water.

I recommend that studies be made at once, and followed up with suitable action, to devise an acceptable way of dealing with the waste water from a severe nuclear accident.

RESPONSE TO THE SECRETARY'S REQUESTS

In addition to requesting that I perform a safety review of the N-Reactor, you requested that I comment on the Chernobyl-4 accident as it might apply to the N-Reactor.

I have reviewed the written material relevant to the Chernobyl-4 type of reactor and to the Chernobyl-4 reactor itself. The literature is voluminous and informative, and serves to emphasize certain critically important differences between the Chernobyl-4 and N-Reactor. In particular, the positive void coefficient of reactivity at Chernobyl, the very complex systems for controlling reactor power and power distribution, and the essential absence of any meaningful containment are notable.

In the course of my review of the N-Reactor, I gave special attention to the question of how it is known that the N-Reactor void coefficient is negative and how the reactor power distribution is controlled. On both counts the N-Reactor is far safer and simpler than Chernobyl. I have commented above on the N-Reactor containment situation which, while of concern, is certainly to be preferred to that at Chernobyl-4, and is, in my opinion capable of adequate correction.

The principal management lesson to be learned from the Chernobyl accident is the necessity for having good procedures, good training in their use, and close supervision to see that they are used. This is part of my reason for strongly urging INPO reviews of the N-Reactor on a regular basis.

The principal technical lesson is that reactors with void coefficients, which are positive over any appreciable part of the operating range, are not suitable for power production without extensive automatic noncancellable safety features that the RBMK reactors do not have. Because of the important basic differences between the RBMK reactors and the N-Reactor, an accident of the Chernobyl type would be impossible in the N-Reactor.

The Deputy Secretary of the Department of Energy also made a request for comments on the reports of the three review teams that had been created by the Department to do reviews on the N-Reactor. Those reports are identified at the beginning of this report. I have reviewed all of them and believe they represent thorough reviews in their respective areas. Their conclusions and recommendations are well founded and I support all of them. The Deputy Secretary also asked for an appraisal of the N-Reactor and its operation. As earlier stated, I believe that the reactor is being operated safely. This does not preclude the identification of ways in which improvements could and should be made.

In closing, I wish to express my appreciation of the very efficient and insightful assistance provided during this study by Mrs. Marilyn S. Smith of the DOE Office of Energy Research, by Dr. John Ireland, and by Dr. Glen Graves, both of the Los Alamos National Laboratory. Their staff work was excellent and of much value.

Sincerely,

/s/

Miles C. Leverett
Consultant

Updated August 1986

EDUCATION AND EXPERIENCE RECORD

MILES C. LEVERETT

BORN:	December 18, 1910, Danville, Illinois
FAMILY STATUS:	Married, no children
GRADE AND HIGH SCHOOLS:	Kansas City, MO and Kansas City, KS
UNIVERSITIES:	Kansas State University: B.S. Chemical Engineering - 1931 University of Oklahoma: M.S.E. Petroleum Engineering - 1932 Massachusetts Institute of Technology: D.Sc. Chemical Engineering - 1938

EMPLOYMENT:

1932-33	Marathon Paper Mills Co., Menaska, WI, Chemist. Worked on waxed paper processes.
1933-35	Phillips Petroleum Co., Bartlesville, OK, Chemist. Developed chemical procedures for stimulating production of oil from wells. Developed chemicals for treating oil field emulsions.
1938-42	Humble Oil & Refining Co. (now Exxon), Houston, TX, Research Associate. Did pioneering work on processes by which oil, gas and water migrate in oil fields. Several patents and papers.

MCL/cb/3934ST86

1942-43 Manhattan Project, University of Chicago, Associate Director - Technology Division. Did heat transfer and fluid flow on first helium-cooled reactor design for Pu production. Hold design patents.

Did heat transfer, fluid flow and general preliminary design work on first water-cooled Pu production reactors, later built at Hanford, WA. Was lead engineer in this work.

Did exploratory experiments and calculations on novel types of reactors, including BWR type.

Several patents and reports.

1943-48 Clinton Laboratories (Later Oak Ridge National Labs), Oak Ridge, TN - Director, Technical Division.

Directed groups which:

Modified air-cooled graphite reactor to increase power by 250%.

Designed, built and operated radium encapsulation facility

Designed, developed and operated factory to produce multi-kilo curie quantities of Ba^{140} from fission products.

Designed, developed and built facility for treatment and storage of fission product wastes from Pu separation plant.

Designed and developed high power density reactor core, which later became the Materials Testing Reactor (Idaho Falls) and is the prototype of all existing high power density test reactors.

Did earliest experiments on measurements of atmospheric dispersion of radioxenon, radioiodine, etc.

Made first presentation for a new reactor to group which later was designed at ACRS. Set pattern for reactor safety reviews.

1943-48 (continued)

Designed optical equipment for close inspection of hot fuel elements.

Supervised early work by architectural firms who later designed the permanent ORNL buildings.

1948-49 Humble Oil & Refining Co., Houston, TX - Senior Research Associate.

Continued pre-war work. Additional papers and inventions. Developed basic technique for estimating oil and gas content of oil sands. Technique and principles are still in use.

1949-51 Fairchild Engine and Airplane Co., "Nuclear Energy for Propulsion of Aircraft" (NEPA) Project, Oak Ridge, TN - Technical Director.

Managed 200-man team of chemists, metallurgists, ceramists, stress and structural engineers, aerodynamicists, aeronautical engineers, physicists, instrumentation and electronic engineers, biologists and health physicists.

Developed the two most promising concepts for nuclear-powered flight.

Had extensive interaction with AEC, USAF, USN, aircraft manufacturers and aircraft engine companies.

1951-61 General Electric Co., Aircraft Nuclear Propulsion Department, Evendale, OH - Manager - Engineering.

Managed 800-man team of chemists, ceramists, metallurgists, physicists, stress and structure engineers, aircraft engine specialists, control and instrumentation specialists, health physicists, test engineers and computer specialists.

Built an outstanding laboratory and development facility and organization. Pioneered extensively in high temperature materials, originating much technology later used in the Space Program and elsewhere.

1951-61 (continued)

Built first and only aircraft-type engines to be powered by nuclear reactors, later tested successfully at Idaho Test Station.

Became charter member (1956) of GE Reactor Safeguards Committee which reviewed all work done by GE Atomic Power Equipment Department on commercial nuclear reactors. Continued as a member of this group until 1964 when it was broadened to cover all potentially hazardous activities of GE. Became chairman at that time, continuing until 1967 when the Committee was discontinued. Then took on full-time safety/quality/reliability duties at San Jose.

Aircraft project was discontinued by government in 1961.

1961-62 General Electric Co., Hanford Laboratories, Richland, WA - Consulting Engineer.

Made numerous special studies for management on methods of improving plant operation, safety, possible new products.

Plants studies included production reactors, fuel manufacturing plants, fuel reprocessing plants, test reactors, plutonium recycle reactors.

1962-67 General Electric Co., Hanford Atomic Products Department, Richland, WA - Manager - Research & Engineering.

Had charge of technical and safety aspects of the construction completion, pre-op testing, startup and operation of the N-reactor, a combination Pu producer and power producer. (N-reactor led the world in electrical energy generation for many years).

Solved numerous problems in corrosion, mechanical, fuel, vibration, control, power distribution, by-product production, steam generation, safety and electronic breeds typical of a new power reactor.

Developed methods for producing tritium and other valuable radioisotopes as by-products.

MCL/cb/3934ST86

1967-75 General Electric Co., San Jose, CA - Manager - Safety & Quality, later Manager - Nuclear Safety Assurance.

Responsible for overseeing all nuclear safety activities in Nuclear Energy Division, and advising Division General Management.

Reviewed all new product design features.

Reviewed procedures, organizations, methods of all NED departments where safety could be a consideration.

Followed each project from inception to turnover; reviewed any special safety, reliability problems.

Conducted Operational Readiness Review on each plant several months before fuel loading. Consisted of leading a team of experienced engineers in a study of the project and its history, and a comprehensive review of the actual plant, looking for anything which might interfere with safe and reliable startup and operation.

Participated in corporate office studies of fuel reprocessing, nuclear reactor business, etc.

Consultant to Oak Ridge National Laboratory on its Nuclear Safety Program.

Consultant to Lovelace Foundation (Albuquerque) on its Fission Product Inhalation Program.

Consultant to United Nuclear Industries (Richland, WA) on N-Reactor.

Set up and managed Division Quality Assurance organization.

Member since 1969 of Niagara Mohawk Safety Review and Audit Board, with cognizance over Nine Mile Point Unit 1, Nine Mile Point Unit 2 (future), and J.A. FitzPatrick Nuclear Power Plant, operated by Niagara Mohawk.

MCL/cb/3934ST86

1976-86	Private consultant on nuclear power reactor safety. Consulted for General Electric and various utility and other reactor owners or operators. At Electric Power Research Institute: Oversaw first comprehensive industry report on Three Mile Island accident. Chaired Industry Degraded Core (IDCOR) Technical Advisory Group. Consulted on Source Term Program. Participated in setting up Institute of Nuclear Power Operations (INPO)

PROFESSIONAL ACTIVITIES AND HONORS:

Sigma Xi, member Society for Risk Analyses, member
American Chemical Society (former member)
American Institute of Mining and Metallurgical Engineers (former member)
American Physical Society (former member)
American Institute of Chemical Engineers (members)
  Received Robert E. Wilson Award, 1976
National Academy of Engineering, member
Former member Visiting Committee, Pennsylvania State University, Nuclear Engineering Department
Former member Visiting Committee, Massachusetts Institute of Technology, Nuclear Engineering Department
Former Chairman, American National Standards Institute Nuclear Standards Committee

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MCL/cb/3934ST86

N-REACTOR AND TYPICAL RBMK-1000 COMPARISONS

A. Overall Design Characteristics	N-Reactor	RBMK-1000
Reactor type	Horizontal pressure tube-pressurized water-graphite moderated	Vertical pressure tube-boiling water-graphite moderated
Design power generation (MWt)	4080	3140
Electrical power generation (MWe)	860	1000
Inlet temperature (avg. °F)	400	518
Outlet temperature (avg. °F)	543	543
Average steam quality at core exit (%)	0.0	14.5
Operating pressure (outlet psia)	1600	1037
Total reactor coolant flowrate (lb/h)	83.2×10^6	82.5×10^6,
Total number of pressure tubes	1003	1693
Lattice spacing	9 in. vertical x 8 in. horizontal	9.8 in. x 9.8 in.

B. Fuel Design		
Design	Tube-in-Tube Annular	Two 3.5 m 18 rod elements in series
Fuel material	U-metal	UO_2
Amount (MT)	365	192
Length (ft.)	34.8	22.96
Orientation	Horizontal	Vertical
Enrichment (%U^{235})	0.7-1.25	1.8-2.0
Average burnup (MWD/MTU)	1000-	20,000
Maximum channel power (MW_t)	5.0	3.0
Cladding	Zr-2	Zr/Nb
Pressure tube OD (in.)	3.26	3.46
Pressure tube wall thickness (in.)	0.275	0.157
Pressure tube material	Zr-2	Zr/Nb

C. Moderator Design		
Material	TSX graphite	Graphite
Operating temperature (°F)	932	1292
Amount (MT)	1800	2000

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2. A. P. Aleksandrov, et al., "Physical and Power Startup of the First Unit of the V. I. Lenin Nuclear Power Station, Leningrad," Atomnaya Energiya 37 (2), 99-107 (1974) (translation).

3. A. P. Aleksandrov and N. A. Dollezhal', "Development of Uranium-Graphite Channel Reactors in the USSR," Atomnaya Energiya 43 (5), 337-343 (1977) (translation).

4. E. P. Anan'ev and G. N. Kruzhilin, "Radioactive Safety Barriers in Nuclear Power Stations," Atomnaya Energiya 37 (1), 22-27 (1974) (translation).

5. R. W. Andrae, et al., "A Review of Four Safety Aspects of the Savannah River Production Reactor," Los Alamos National Laboratory letter report (Q-6) (August 1984).

6. M. Berman, "Hydrogen Behavior and Nuclear Reactor Safety," in *Recent Developments in Hydrogen Technology, Vol. II* (CRC Press, Inc., Boca Raton, Florida), Chap. 2, pp. 35-67.

7. M. Berman, "A Critical Review of Recent Large-Scale Experiments on Hydrogen-Air Detonations" (to be published in *Nuclear Science and Engineering*).

8. H. W. Bertini, "Descriptions of Selected Accidents that have Occurred at Nuclear Reactor Facilities," Nuclear Safety Information Center, ORNL/NSIC-176 (April 1980).

9. V. I. Budnikov, et al., "Stability of the Radial and Azimuthal Energy Distribution in a Boiling-Water Reactor," Atomnaya Energiya 45 (5), 331-335 (1978) (translation).

10. A. L. Camp, et al., "Light Water Reactor Hydrogen Manual," NUREG/CR-2726, SAND82-1137, Sandia National Laboratories and General Physics Corporation (1983).

11. A. L. Camp, et al., "HECTR Version 1.0 User's Manual," NUREG/CR-3913, SAND84-1522, Sandia National Laboratories (1985).

12. Yu. M. Cherkashov, et al., "Mathematical and Experimental Study of Emergency Cooling of RBMK-1500 Reactor in Case of Maximum Credible Accident," Russian 4, 23-33 (1981) (translation).

13. V. M. Chernyshenko, "Construction Parameters for Chernobylskaya AES Given," Russian 11, 2-6 (1984) (translation).

Special Appointment
August 1, 1986
DOE-Forrestal Building
Washington, DC

SUBJECT: Request for Additional Information

Consultants Present: Roddis, Tape, Wilkinson

DOE Representatives Present:

J. Salgado, Under Secretary, DOE

M. Walker, Assistant Secretary for ES&H, DOE

A. Trivelpiece, Assistant Secretary for Energy Research, DOE

J. Gilbert, Executive Assistant to the Assistant Secretary for Defense Programs, DOE

E. Hanrahan, Special Assistant to the Under Secretary (DOE)

1st Joint Briefing
May 22-23, 1986
DOE--Forrestal Building
Washington, DC

Consultants Present: Roddis, Tape, Pigford, Lewis, Leverett

Speaker	Title & Organization	Subject
E. Hanrahan	Special Assistant to the Under Secretary (DOE)	EPA Task Force on Chernobyl
D. Bunch	Deputy Assistant Secretary for Nuclear Energy, DOE	Chernobyl Accident
M. Walker	Assistant Secretary for ES&H, DOE	DOE Reviews of N-Reactor
G. Oertel,	Deputy Assistant Secretary for Safety, Health & Q.A., DOE	Quick Response Safety Review of N-Reactor in Light of Chernobyl
N. Klug	Team Leader for N-Reactor Special Safety Review, DOE	
C. Simpson,	Director of Office of Nuclear Materials Production, DOE	N-Reactor Safety Programs
J. Ford	Office of Nuclear Materials Production, DOE	
J. Salgado,	Under Secretary, DOE	Briefing to Consultants on DOE Issues Concerning Chernobyl and N-Reactor
S. Foley,	Assistant Secretary for Defense Programs, DOE	
M. Walker,	Assistant Secretary for ES&H, DOE	
A. Trivelpiece,	Assistant Secretary for Energy Research, DOE	
E. Hanrahan	Special Assistant to the Under Secretary, DOE	

October 1, 1986

The Honorable John L. Herrington, Secretary
US Department of Energy
1000 Independence Avenue, S.W.
Washington, DC 20585

Dear Mr. Secretary:

I was contacted by Dr. Alvin Trivelpiece, your Director of the Office of Energy Research, to become one of six independent members of an Ad Hoc consultant group to examine the technical and safety aspects of the Hanford N-Reactor in light of the Chernobyl accident.

Enclosed is my report concerning this subject.

Respectfully,

E P Wilkinson

E. P. Wilkinson

N-REACTOR SAFETY IN LIGHT OF THE CHERNOBYL ACCIDENT

E. P. Wilkinson

I was contacted by Dr. Alvin Trivelpiece, your Director of the Office nergy Research, to become one of six independent members of an Ad Hoc sultant group to examine the technical and safety aspects of the ford N-Reactor in light of the Chernobyl reactor accident.

Our group was initially charged to:

- Review the facts and findings surrounding the Chernobyl accident.
- Based on those facts and findings, examine N-Reactor operations and safety procedures to ensure that all key technical questions and potential safety issues raised by the Soviet accident have been considered.
- Examine the information and findings from the Department's own safety reviews of N-Reactor to ensure that the relevant facts and findings from the Chernobyl accident have been addressed by the DOE teams.

Additional charges were added by Under Secretary Salgado in an early meeting with the independent consultants:

- Are all important issues being adequately addressed?
- Is the N-Reactor being operated safely?
- If not, can the N-Reactor be operated safely?

In carrying out my part of that tasking, I have had the benefit of:

- Charge letter to consultants,
- Voluminous material as shown in an extensive bibliography of documents,
- Several joint and special briefings as shown in schedule of agendas with supporting back-up material,
- A table showing comparisons of the N-Reactor and the Soviet RBMK-1000-type reactor,
- Back correspondence from the ACRS concerning the N-Reactor,
- N-Reactor Safety Assessment by Intex (Dietrich Report June 1983),
- Report of quick review by the DOE special safety team that examined graphite fire and confinement issues,

- Technical safety appraisal of the N-Reactor (July 1986),
- GAO report on nuclear safety comparison of DOE's Hanford N-Reactor with the Chernobyl reactor (August 1986),
- USSR State Committee report on the accident at the Chernobyl nuclear power plant and its consequences (August 1986),
- Design review of the N-Reactor (September 1986),
- DOE draft action plan to address recommendations from the N-Reactor special safety review, technical safety review, and design review,
- Cumulative analysis of ESH's N-Reactor reviews,
- Visits to DOE Headquarters, the N-Reactor at Hanford, and the Los Alamos National Laboratory, and
- Interaction and discussion with the five other members of the Ad Hoc consultant group, namely Dr. Miles C. Leverett, Professor Harold W. Lewis, Professor Thomas H. Pigford, Mr. Louis H. Roddis, Jr., and Dr. Gerald F. Tape.

The consultants carried out their investigations concurrently with the various DOE review groups. From review of that extensive amount of information and from my own experience, I have drawn conclusions and recommendations which are my own and which are expressed in summary form later in this report.

I wish to recognize the support of the DOE staff, both at Richland and Headquarters, of the contractor, UNC, and of staff at the Los Alamos National Laboratory. I especially appreciate the very efficient and thoughtful assistance of Mrs. Marilyn S. Smith of the DOE Office of Energy Research, and of Dr. John R. Ireland and Dr. Glen Graves, both of Los Alamos National Laboratory.

The requested review of the facts and findings surrounding the Soviet reactor accident at Chernobyl, N-Reactor operations and safety procedures, key technical questions and potential safety issues raised by the Soviet accident, the information and findings developed by the Department's safety reviews of the N-Reactor, and other information made available, and as tabulated previously, lead me to the personal conclusions and recommendations that follow.

Conclusions

1. There are no known deficiencies that mandate an immediate shutdown of the N-Reactor for safety reasons.

2. The various DOE safety reviews appear to have been competently done. In the aggregate, the number of discrepancies identified is significant and indicates that prompt corrective action is required.

3. Historically, the N-Reactor has not always been kept up to date on safety-related design changes or maintained in an excellent material condition.

4. The N-Reactor is not as safe as our US commercial plants. It should be recognized by the DOE that it does not meet all present-day standards for commercial reactors.

5. The N-Reactor can be operated safely. But, numerous improvements are needed operationally, administratively, in maintenance, in training, and in design modifications to enhance the level of operational safety and to support continuing operations for the next several years.

6. Compared to our commercial reactors there is a considerably greater man-rem exposure for N-Reactor personnel.

7. The N-Reactor has exceeded its nominal 20-year life. Items such as graphite growth, zircalloy-2 tube embrittlement, and long-term deterioration of components indicate the necessity of final shutdown, or complete renovation in the early 1990s.

8. There are major safety-related design differences between the N-Reactor and the Chernobyl reactor. The N-Reactor, for example, has a negative void coefficient, much less complex controls, two independent fast-acting scram systems, and is shutdown for refueling. The series of operating errors, conduct of special tests not compatible with reactor control, disabled safety systems, and disregard of procedures that occurred at Chernobyl are almost unbelievable. It is considered that there are more rigid controls and adherence to procedures at the N-Reactor. It appears that in the event of a major accident at the N-Reactor there could be containment failure similar to that at Chernobyl. But, in that event, the impact on the surrounding area would be much less because of the lesser population density. In summary, an accident of the type that occurred at Chernobyl is not plausible at the N-Reactor.

9. There is an apparent sense of complacency at many levels from the DOE staff on down through contractor operations personnel that "it can't happen here" at the N-Reactor. The major lesson from TMI-2 and Chernobyl-4 is that accidents can happen and, if they do, they may not match postulated scenarios. The possiblity of a major accident at the N-Reactor with significant release of radioactivity cannot be ruled out. The DOE should evaluate the degree of risk versus the need for production of defense materials. In that evaluation, the risk that a major accident with significant release of radioactivity to the environment would pose to the future of nuclear energy use in the US should be considered.

10. The hydrogen issue has not been adequately considered or answered.

11. The discharge of primary coolant into the soil is a poor practice and poses an environmental threat.

Recommendations

1. DOE review the risk, including the risk to the future of nuclear energy use in the United States, and make a decision as to whether to continue the operation of the N-Reactor. If the decision is to continue, then there are some high-priority operational, administrative, maintenance, training, and design modifications to accomplish to enhance the level of safe operation. Make the commitment to provide the resources to accomplish them.

2. If the N-Reactor facility is required for long-term production of defense material, recognize that major renovation or replacement will be required in the early 1990s. A replacement design could meet commercial standards and provide such features as containment, mitigation, better maintenance, lower man-rem exposure, etc. DOE should conduct a review and make a decision on this issue in a timely manner.

3. An action plan is under preparation to address deficiencies identified and recommendations from the N-Reactor special safety review, technical safety review, and the design review. Expand that action plan to include consideration of all known deficiencies from other sources. Prioritize items to be accomplished. Incorporate them into a living schedule. Provide the resources to accomplish them. Set up an action tracking system to follow up to ensure that schedule commitments are met.

4. Expand the training programs to cover personnel involved in operation, maintenance, support, and supervision of the N-Reactor. Ensure that training conducted meets the job requirements. Set up training and qualification standards patterned after the INPO criteria for commercial reactors. Include review of simulator training. Arrange for INPO assistance followed by accreditation reviews by INPO.

5. The N-Reactor is a special participant in INPO. Arrange for an early INPO operational evaluation. Arrange for continuing periodic INPO evaluations with their follow-up benefits.

6. Arrange for an INPO emergency preparedness review.

7. Assign a special group to review all recommendations related to deficiencies to identify underlying root causes so that action can be taken not only to correct deficiencies, but also to minimize probability of occurrence. It is understood that this is being set up under Del Bunch.

8. The potential hydrogen generation at the N-Reactor is greater than that at Chernobyl and many times greater than in our commercial reactors. Hydrogen mitigation should be provided. Hydrogen generation and distribution should be evaluated under various scenarios. Hydrogen indication equipment and more extensive compartment inerting and/or igniters should be provided.

9. Expedite conduct of a level 3 PRA. Ensure that personnel who will have long-term involvement with the N-Reactor participate.

10. Primary coolant discharge to the surrounding soil should be stopped. An ion exchange system is needed to purify primary coolant. In the event of a severe accident, a method to contain the waste water until it can be decontaminated is needed.

11. Certain modifications to design requirements have been endorsed by many reviewers, such as, remote shutdown capability, control room habitability, and backup emergency core cooling. Assign priority attention to their accomplishment.

12. Improve the effectiveness of the quality control and quality assurance programs at the N-Reactor.

13. Ensure that there is an effective on-site and off-site review of off-normal events that occur at the N-Reactor to ensure that underlying root causes are identified so that corrective measures can be taken.

14. Expand surveillance and monitoring of the N-Reactor to refine the estimate of date of end of normal life. In addition to zircalloy-2 tube embrittlement and graphite growth, include selected valves, systems, and components.

15. Establish a permanent system of outside technical review.

GERALD F. TAPE
CONSULTANT
5717 TULIP HILL TERRACE
BETHESDA, MARYLAND 20816
—
(202) 462-1676
(301) 229-6264

October 1, 1986

The Honorable John S. Herrington, Secretary
U. S. Department of Energy
Washington, DC 20585

Dear Secretary Herrington:

In accordance with the request in your letter of May 2, 1986, I have carried out a review of N-Reactor safety in the light of the Chernobyl accident. My report is enclosed.

It is generally concluded that the initiating event leading to the accident at Chernobyl could not occur at N-Reactor. There are, however, lessons to be learned from the accident. In my view, a major beneficial consequence has been the stimulation of the U. S. to conduct extensive reviews of N-Reactor safety and more thoroughly to examine very low probability but high consequence potential accidents.

The Department's reviews have been extensive. No safety related matter so serious as to warrant shutdown of the N-Reactor has been discovered. I support this finding. My report contains a number of recommendations, many of them overlapping those included in the various Departmental reviews.

Implementation of recommendations requires setting priorities and providing funding by the Department. Development of a logical action plan must be preceded by a determination of the short- and long-term role of the N-Reactor. I urge you to make such a determination promptly.

I wish to express my appreciation to the many persons who, in the Department, both headquarters and field, and in the contractor organizations, have provided briefings and special materials. The joint briefings arranged for all of the consultants appointed by you have been most beneficial.

I appreciate the opportunity of assisting the Department of Energy in this important matter. I would be pleased to provide further information, if you desire.

Sincerely,

Gerald F. Tape

Gerald F. Tape

N-Reactor Safety In The Light Of The Chernobyl Accident

Gerald F. Tape

Secretary Herrington requested six consultants to assist him in the Department of Energy's review of the N-Reactor design and operation in the light of the Chernobyl accident. Specifically, the consultants were to probe for safety related matters that were revealed in the examination and understanding of the Chernobyl accident and that had not previously been factored into the contractor's management and operation or the Department's oversight of ensuring safe operation of the N-Reactor.

The initial charge was as follows:

- The consultants will review the facts and findings surrounding the Soviet reactor accident at Chernobyl.
- Based on these facts and findings, the consultants will examine the N-Reactor operations and safety procedures to ensure that all key technical and potential safety issues raised by the Soviet accident have been considered.
- The consultants will also examine information and findings developed in the Department's safety reviews of the N-Reactor to ensure that the relevant facts and findings from the Soviet accident have been addressed by the review teams.

In an early meeting of the consultants with Under Secretary Salgado, he amplified the charges by asking several questions:

- Are all important issues being adequately addressed?
- Is the N-Reactor being operated safely? If not, can the N-Reactor be operated safely?

The Process

The consultants participated jointly in many meetings to receive briefings, to identify unanswered questions requiring further study, and to visit the N-reactor plant and talk to the contractor. The details of these common activities are to be found in the Appendix to this report. The support of the DOE staff, both at headquarters and Richland, and of the contractor, UNC, is gratefully acknowledged. Especially noteworthy are the contributions of Marilyn S. Smith, Special Assistant to the Director of Energy Research, and Drs. John Ireland and Glen Graves of the Los Alamos National Laboratory.

For the most part, it was necessary for the consultants to carry out their activities in parallel with the various Departmental review groups. The N-Reactor Technical Safety Appraisal Report was issued in late July and the Design Review Report in early September. The definitive technical information on the Chernobyl accident was released by the Soviets in late August. The findings by this consultant are based on the above noted reports and other information obtained from common briefings, discussions, and available reports. Especially valuable was the participation of, and the opportunity to exchange views with, the other consultants appointed by the Secretary of Energy, namely Dr. Miles C. Leverett, Prof. Harold W. Lewis, Prof. Thomas H. Pigford, Mr. Louis H. Roddis, Jr., and Admiral (Ret.) Eugene P. Wilkinson. The conclusions and recommendations contained herein are this consultant's (GFT) sole responsibility.

In the material that follows, the attempt will be made to differentiate between safety issues that relate to prevention of a major accident in the first instance and those that relate to mitigation of the consequences should an accident occur. Further, a more narrow approach is taken than that in the Technical Safety Appraisal by addressing only nuclear safety related issues and not industrial and worker safety, unless such might be contributing factors to a major nuclear accident.

Chernobyl

A first order of business for the consultants was to determine and understand the design features of the RBMK and to compare them with the N-Reactor. This was done by reviewing documents and receiving briefings from U.S. experts who had studied the design (see Appendix). There are a number of very important safety-related differences, some of which played a major role in the Chernobyl accident. These have been documented in the Design Review of the N-Reactor (see section 8.0). Significant differences providing inherent safety advantages for the N-Reactor include:

- o Negative void coefficient,
- o Horizontal process tubes,
- o Graphite and shield cooling,
- o Two independent scram systems, both fast, and
- o Shutdown during refueling.

At a relatively early time following the accident, the Soviets disclosed the fact that a test was underway at the time of the accident; the details became clear during the August IAEA Vienna meeting. It is difficult to comprehend the circumstances, including disabled safety systems and disregard of the RBMK's operating sensitivities, that permitted the test to be made.

There are, however, lessons to be learned. From Chernobyl and from Three Mile Island, the message is that if a major accident happens, it is likely to result from an unanticipated scenario and to involve steam and/or hydrogen. Thus the problem is how to prevent the unanticipated from becoming a severe accident and how to achieve mitigation, that is, controlling steam and/or hydrogen to the extent necessary to maintain the integrity of confinement or containment systems.

The DOE Reviews

Three DOE review reports have been issued. The first, a quickie review by the Special Safety Team, examined graphite fire and confinement issues. The principal recommendations were directed at questions of hydrogen generation and control and at operational reliability of the confinement system. These are more fully addressed in the Technical Safety Appraisal and Design Review Reports and will not be discussed at this point.

Technical Safety Appraisal of the N-Reactor (July 1986)

The report concludes that "No indications were found that a serious accident is likely to occur at N-Reactor, or that contractor employees or the general public are being subjected to unacceptable risks." The review team offered 51 recommendations directed toward enhancement of safety.

The report makes a good start in categorizing the various recommendations which cover all aspects of safety from normal to accident conditions. None was found to be in the nature of a deficiency that might compromise safe operation of the reactor.

This consultant finds the work of the Technical Safety Appraisal Team extensive and satisfactory. One must bear in mind that its charge goes beyond the narrowly defined one of reactor safety. It does emphasize a concern for complacency, a common problem facing operators of established high technology endeavors that have had a long record of successful operation. To the extent that there exists a laissez-faire approach in normal industrial safety areas, one must be concerned about a carry over to nuclear safety matters. Continuing attention is needed to overcome and prevent complacency.

Because of the variety of objectives covered by the 51 recommendations, establishment both of priorities for their implementation and of an action plan are necessary.

Design Review of N-Reactor (September 1986)

The Design Team concluded that "..the N-Reactor is safe to operate and that there is no reason to stop or alter its operation in any major respect at this time." Certain additional analyses and testing are recommended to provide a firmer basis for decisions on long-term operations. Fifty-two recommendations have been made by the Review Team. These are categorized, for the most part, within eight areas and listed in section 1.4 of the report. Several can be described under accident prevention, e.g. pressure tube surveillance and replacement, graphite and shield cooling, redundancy for ECCS coolant, while others can be described under mitigation of consequences, e.g. confinement testing, environmental qualification. The recommendations to expedite and extend the probabilistic risk assessment (PRA) to a full scope level-3 and to upgrade analytical capability, especially best-estimate calculational capability, will better serve to identify serious risks in both categories.

This consultant finds the work of the Design Review Team to be exhaustive and well done. The key issues have been addressed and where information is incomplete or inconclusive, or analyses less than thorough, additional work has been recommended. However, as with the Technical Safety Appraisal recommendations, priorities and an action plan need to be established.

Early in September, the Under Secretary was provided with a cummulative analysis of ESH reviews. This is a good first step in preparing an action plan. The consultants have been advised that such a plan is under development.

Chernobyl-Lessons Learned

1. It is this consultant's opinion that a Chernobyl-type initiated accident cannot happen at N-Reactor. Existing management policies and operations practices preclude carrying out the type of test that initiated the accident sequence at Chernobyl. Although graphite is common to the two reactors, it did not participate in the accident. Safety-wise, the design features and operating conditions of N-Reactor are far superior to those of the RBMK.

2. Chernobyl and Three Mile Island have demonstrated that for the severe accidents that did happen, the initiating event was unanticipated, that is,it was not previously treated as credible.

3. Given the possibility of an unanticipated major accident at N-Reactor, the seriousness of the consequences will most likely be governed by the presence of steam and hydrogen and the ability to control high pressures and/or prevent explosions in the confinement space.

Accident Prevention at N-Reactor

Credible accident scenarios have been examined in detail and designs and operating procedures established to prevent them.

1. What special measures then, can be adopted to prevent the unanticipated?

- Professional training and education carried out at all levels on a continuing basis, especially education to enable supervisors to respond quickly and responsively to the unusual or unexpected.

- Quality maintenance and especially surveillance of aging components along with a positive replacement program (process tubes, graphite.)

2. N-Reactor has been operated safely for over 20 years. A new generation of managers and operators has replaced the original designers, builders, and operators: Success can breed complacency. The hi-tech nature of reactors cannot tolerate complacency in either operations or maintenance.

Mitigation of Consequences

Chernobyl and Three Mile Island demonstrated that the most significant factors effecting mitigation of consequences were control of high-pressure steam and of hydrogen and control of release of radioactivity to the environment. At Chernobyl, steam and/or hydrogen explosions destroyed their ability to control the release of radioactivity.

1. Hydrogen generation under accident conditions has been examined for the N-Reactor, but there remain some uncertainties that require further investigation.

2. The N-Reactor confinement has been designed to provide for controlled releases to the environment under accident conditions. There remain major questions as to whether, after 20 years of reactor operation and no opportunity for a true system test, all components of the confinement system would indeed operate as designed and programmed. Continuing surveillance and tests of vital components are necessary.

General

1. Public perception, whether factually correct or not, is important. Confinement can be an acceptable method of mitigation; however, containment tends to be perceived by the public as superior. The NRC requirement of containment for nuclear power reactors reinforces that view. In a similiar way, "licensing" by a body independent of the plant owner-operator is perceived as a more safety-credible process. While DOE has taken steps in this direction by establishing ESH, DOE remains both owner-operator and regulator of the N-Reactor.

2. DOE lines of authority and responsibility are multi-layered, long and complex. At Headquarters there are two independent organizational units, Defense Programs (DP) for N-Reactor "operations" and Environment, Safety and Health (ESH) for "regulation," each reporting to the Under Secretary. There is a similar structure at the field office level where the Manager has parallel groups. Yet, the day-to-day operating responsibility is with the contractor. The chain is long, complex, and burdened by too many people.

3. The several DOE review teams have concluded that operation of the N-Reactor is safe, but then offer many recommendations for enhancement. These need to be put

in context and prioritized. Early establishment of an action plan will put them in perspective and indicate the seriousness of DOE's and the contractor's attention to safety. It is understood that a plan is under development; however, DOE will be judged by the decisions made, timely funding, and early effective implementation.

Conclusions and Recommendations

The work of the DOE Review Teams has been comprehensive. No deficiencies have been uncovered that would mandate immediate shut down of N-Reactor for corrective action.

I. The recommendations, which are now being prioritized and for which an action plan is being developed, generally are directed toward investigations, analyses, operational improvements, and equipment and facility changes that are required for the near- term safe operation. Many, of course, would serve longer term requirements. It is recognized that several very major changes, e.g. replacement of graphite and process tubes, would be required in the N-Reactor plant, if operation into the 21st century is to be achieved. The timing for such major reconstruction is uncertain. If future defense production requirements are such as to require the equivalent of an N-Reactor on-line after the mid-nineties, they should be met by a new production reactor and not a rebuilt N-Reactor. Finally, a decision now, not to rebuild the N-Reactor will facilitate decisions and actions required to meet near-term safety needs.

Recommendation: DOE should decide now that the safety enhancement program for the N-Reactor will be directed toward its continued operation for the next 5 to 10 years and that its operational life will not be extended beyond its "natural life."

II. The Review Teams have made a large number of recommendations. They encompass a range from nuclear reactor specific to industrial safety issues. Many can be implemented by the contractor in the normal course of operations and maintenance. Others will require DOE actions such as authorizing extended shutdowns to accommodate changes, testing, replacements, etc., funding of urgent investigations and studies by UNC and others, and funding for equipment and facility changes and additions.

Recommendation: In conjunction with the contractor, prioritize the numerous recommendations with respect to implementation and, on an urgent basis, establish and fund action plans consistent with N-Reactor operations for the short term.

III. The basis for approval of the operation of the N-Reactor is the NUSAR. Assumptions are based on a combination of experimental facts, theory, analyses, and experience. In the course of the DOE reviews, especially the Design Review, and the Consultants' Reviews, questions have been raised concerning some of the assumptions adopted. The Chernobyl accident has certainly focussed attention on hydrogen generation and control. Although a probabilistic risk assessment (PRA) is under way, the questions raised have underscored the value of extending it to include all levels, i.e., PRA-2 and -3.

Recommendation:

A. Re-evaluate the generation and control of hydrogen under accident conditions. Investigate the methods of prevention of build-up of explosive mixtures and detonation, for example, controlled burning, recombiners, inerting.

B. Expedite and expand the PRA analysis. The contractor should be intimately involved, but the magnitude of the task and the urgency requires responsibility to be assigned to one organization with the authority to draw on the resources of other groups on an expedited basis. Some questions cannot wait for the PRA results and should be addressed in the interim on a best-estimate basis.

IV. Confinement is the key to mitigation of off-site consequences. Effective operation of the confinement system as designed and programmed is necessary. To achieve this, the elements of the system must function properly and, to do so, must first of all be protected from damage by the accident itself. It is recognized that a full systems test of the confinement system is not possible. However, after 20 years, uncertainties have developed. The Review Teams have recognized these and made recommendations.

Recommendation:

A. Analyze and test each component and sub-system of the confinement system to the maximum extent feasible to ensure its proper operation.

B. Re-evaluate the expected chemical forms and quantities of iodine release and the effectiveness of the spray and filter systems in their removal.

V. Accident prevention in the short term must focus on the hands-on on-site response of reactor operators and the proper maintenance of equipment. Training is focussed on the handling of credible accident scenarios. Broader education is required for those whose responsibility it is to make rapid decisions when the unusual or unanticipated event occurs. On the maintenance side, assurance of quality-reliable operation is the objective. It is recognized that process tube failures and graphite growth can be major problems in the next five to ten years. Surveillance to prevent failures is mandatory.

Recommendation:

A. Emphasis must continue on the training function including conforming manuals and simulator performance to actual control room conditions and reactor behavior.

B. Continue to strengthen through education the on-site control room capability to respond to unusual and unanticipated events.

C. Maintain a vigorous surveillance and replacement program, especially with regard to process tube failure and graphite growth.

VI. The review teams identified several situations where separation of safety support equipment or provision for remote operating capability would enhance safety under accident conditions. Some of these projects are now under way, for example, a remote shutdown and monitoring capability.

Recommendation: DOE must facilitate design, funding and construction of identified support equipment where changes are recommended in the interest of reducing vulnerability.

VII. DOE has carried out the present reviews under the direction of the Assistant Secretary for Environment, Safety, and Health. The review teams were composed of experts from the Department of Energy, its contractors, and others. Although the team members are experienced and capable and are separated from Defense Programs, which is responsible for the N-Reactor, the reviews are looked upon by outsiders as an "in-house" operation. The Department should avail itself of peer review services of external "institutions."

Recommendation: DOE should make greater use of external peer review groups to address reactor safety on a continuing basis. The use of external entities such as ACRS and INPO should be pursued.

Concluding Comments and Observations

The specific Chernobyl-4 accident scenario has little relevance to N-Reactor safety consideration. Fundamental differences in design coupled with management and operations policies, regulations, and procedures would have precluded such a test from being carried out at the N-Reactor.

The Chernobyl accident did stimulate DOE and others to carry out extensive reviews of N-Reactor safety. The accident also reinforced TMI-2 findings that the serious accidents that happen are in the category of the unanticipated and are likely to involve hydrogen generation. Thus, to lower the risk of an accident actually taking place, more attention needs to be given to understanding and coping with the extremely low probability, but potential, unusual event. If the accident does occur, more attention needs to be given to preserving the credibility of the confinement/containment system. Here, hydrogen and steam play major roles.

The DOE reviews taken collectively were detailed and comprehensive. They were objective and carried out by qualified persons. Items that require further analyses, change of procedures, equipment modifications or additions are identified. It is understood that an action plan is under development.

The N-Reactor went on line in 1963. The added risk to the public was evaluated as being a very small increment compared to that due to the presence of the other materials production reactors then operating at Hanford. The largest operating reactors of that period were for defense production; power reactors were in the early stages of scale up to larger units. Today, operating reactors are dominated by the power generators, and regulation is by an independent oversight body, the Nuclear Regulatory

Commission (NRC). Comparisons tend to be made now with NRC regulations. The absolute risk of occurrence of an accident due to operation of the N-Reactor is less today than in 1963 because of the wealth of experience gained and the safety upgrades that have taken place in the intervening years.

In looking to the future, the N-Reactor is an aging reactor. One can expect components to fail and to require replacement. One must be assured that such failures are fail safe. The N-Reactor has some unique features such as graphite that undergoes volumetric changes with continued irradiation. There are limits to what changes can be tolerated. Replacement of the graphite and the process tubes (fuel channels) has been proposed. If material production for national security purposes is required of the N-Reactor beyond say 1995, a new production reactor should be constructed. Heroic measures should not be taken to extend the "natural life" of the N-Reactor.

To conclude, it is this consultant's overall opinion that:

- The risk of a major accident at the N-Reactor is comparable to that of a commercial power reactor.
- The risk of consequences to the public from a major accident must be assumed to be higher than from a commercial power reactor because of uncertainties in the control of hydrogen and the effectiveness of the confinement system under accident conditions.
- Assuming a continuing requirement for the production of nuclear material from the N-Reactor for national security purposes, these risks are acceptable.
- Implementation on an urgent basis of the prioritized recommendations of the review teams will contribute to the reduction of present risks and is prudent.
- A decision is needed on the future of the N-Reactor now, preferably one supporting operation for 5 to 10 years followed by permanent shutdown.

September 30, 1986

APPENDIX

1. John S. Herrington, letter to Gerald F. Tape (May 2, 1986).
2. "Herrington Asks Experts to Assist in Reviewing Safety of Department's N-Reactor," DOE News release, May 5, 1986.
3. "Herrington Fills Out Expert Consultant Panel Reviewing N-Reactor," DOE News release, May 7, 1986.
4. Biography for Gerald F. Tape.
5. Schedule of Joint Briefings.
6. Bibliography
7. N-Reactor and RBMK Comparison.

Santa Barbara, California

October 1, 1986

The Honorable John S. Herrington, Secretary
United States Department of Energy
Washington, D.C. 20585

Dear Mr. Secretary:

After the Chernobyl accident in late April of 1986, you asked a half dozen of us to provide you our views on the safety of the N reactor at Hanford, in view of the Soviet event. The N reactor is a light-water-cooled graphite-moderated pressure-tube reactor without a traditional containment, properties it shares with the RBMK-1000 at Chernobyl, but it is otherwise quite different. The reactor has also been operating for nearly twenty-five years, so that, in fact, safety reviews were already under way in the Department, prior to Chernobyl. The response to Chernobyl was to accelerate the internal reviews, to appoint our external group, and, subsequently, to ask the National Academy of Sciences to look at all the production reactors over a longer period. We were promised complete access and cooperation from the Department. This is my report to you on this matter.

Let me say at the outset that your specific wish [your letter of May 2 to Dr. Roddis] to be "absolutely certain ... that there is no possibility of an accident similar to the one that occurred in the Soviet Union" cannot be fulfilled, simply because risk is a matter of degree, and the complete avoidance of risk is a fantasy. I will stress this point throughout, because it seems to be imperfectly understood within the Department. We often heard people opine that the reactor was "safe", and that is a meaningless observation. Decision making involves either overt or subliminal balancing of risks and other costs against benefits. Just as there are (allegedly) no free lunches, there are no risk-free technologies. The risk is real, and no risk is worth accepting without commensurate benefit, while great risks are acceptable in return for great benefits. The benefits associated with operation of the N reactor lie in its provision of special nuclear materials for defense programs, and the assessment of the value of these benefits lies without our charter. Thus, though I can advise you of the implications of Chernobyl for the reactor, and can even say what can be done to reduce the risk, I can only provide a personal view of the implications for continued operation of the reactor. I will do so at the end.

There are many reasons why the N reactor deserved attention long before Chernobyl. It is an old reactor, designed in the '50s, and does indeed lack traditional containment. At over 4000 MW_t it has the highest power level in the United States. It is a unique design, so that the benefits of operational experience in other reactors are of only limited value in the maintenance of its safety. It is often said that it meets all safety criteria for commercial reactors, but that is not particularly meaningful, since only those criteria of broad applicability are relevant to this type of reactor, and there are none that are uniquely relevant. In addition, compliance with regulations is a chancy thing, as those in the commercial field have learned, and one can only learn whether one is in compliance (just as in the law) when the final ruling has been handed down by the final arbiter. This has not been done. Finally, the argument that a reactor that has operated safely for so long must be safe is statistically specious, since the actual operational experience is negligible compared to the level of safety that is required. The Department is to be commended for having started the internal review process before the stimulus of Chernobyl.

The specific details of the accident at Chernobyl are, for the most part, only marginally relevant to the N reactor. The N reactor (I am assured, but have not personally checked the calculations) has a negative void coefficient of reactivity, so the direct cause of the reactivity transient that occurred there is missing here. The graphite fire was a result of the accident, and the main damage was already done when the graphite caught fire, so the graphite moderator is a misleading similarity. Chernobyl has simply provided a reason to take a closer look.

Yet there are similarities which are relevant. Of these, only one is hardware — the lack of conventional containment -- and the remainder are institutional. I will devote much of this report to the latter, so let me begin with containment.

Nuclear safety, as practiced in most parts of the world, is predicated on a philosophy called "defense in depth", which means that there is a sequence of serial barriers to the release of radioactivity to the environment, and that the breach of one barrier leads only to another. A sturdy containment is normally used as the last such barrier, so that disaster within the containment is not likely to lead to release of substantial amounts of radioactivity. There are different ways in which one can allocate safety resources, and there is no *essential* role for containment. It is possible to envisage equally safe reactor designs in which containment plays a greater or lesser role, or even no role at all. Nonetheless, standard practice nowadays is to provide containment as a barrier of last resort.

That was not entirely foreseeable in the late 1950s, when the N reactor was designed. Yet, in 1958, the Advisory Committee on Reactor Safeguards (ACRS, then attached to AEC, now to NRC) wrote a letter about the N reactor, stating that it was "essential" that the reactor be contained. Since the ACRS was an independent advisory body of experts, though functioning within AEC, this was a significant recommendation. In 1960 the ACRS accepted the uncontained design, for reasons which would surely not pass muster today (" containment of this one reactor will not greatly change the overall safety picture at Hanford" and "its use will not significantly increase the present hazards of the Hanford operations"). The other reactors referred to are now all shut down, and I do not know of any comparable external reviews since. From 1960 through 1967, when the letters ceased, the ACRS continued to state that it was its view that the hazards of the N reactor exceeded those of licensed reactors, and that its continued operation "can only be justified by production requirements". Though I am currently a member of ACRS (and therefore have an apparent conflict here, whose effect you must judge) I can not pretend to predict what might happen if the matter were to come up today. What I do know is that all reactors licensed since then, in this country and most others, have been conventionally contained.

My personal view is that I would be disinclined to license a commercial uncontained reactor, barring an extraordinarily convincing demonstration of the low probability of an accident, but that does not lead me to recommend containment for the N reactor. The objective of a safety program, including design, construction, maintenance, and operation, is to protect the health and safety of the public against a major release of radiation. As mentioned earlier, this can be achieved in sequential steps, by reducing the probability of an internal release, and, if such a release occurs, reducing the probability of its escape to the biosphere. There is no magic in the allocation of safety assurance between these two barriers, and one can conceive of equally safe reactors that meet their objectives in different ways. In the commercial field, most of the emphasis has been on preventing severe core damage (aka core melt), with the containment as the final layer of protection. The N reactor has a different emphasis on the various elements of safety, which can in principle be just as good, but which has not been demonstrated to be so. Indeed, the fundamental premise of the N reactor confinement system is that the release of high pressure steam and the release of radioactivity will be sufficiently separated in time to allow valves to close behind the steam and block the subsequent radioactivity release. That was not the case at Chernobyl, but the relevance to the N reactor accident sequences is not clear. This is precisely the sort of question that ought to be answered by a level three probabilistic risk assessment (PRA), as discussed below.

A final point on containment follows logically. If the decision were made to invest the very large sums required to enhance the safety of the reactor, it is not clear that the resources are best spent on containment. It is very likely that analysis would demonstrate that one can buy more safety enhancements in other ways, at lower cost.

Now to other matters. Ours is a diverse group, representing a variety of skills and experience, so it should be no surprise that we have different perspectives. For that reason, I believe that it is healthy that we are filing separate reports -- each can be mined for its separate ore. My own predilections should be obvious from what follows -- I tend to see technical issues in the context of the institutional forms that nurtured them. Therefore, though each of the technical problems can be solved individually (and they are real and must be dealt with if the reactor is to be continued in operation), still more needs to be done if we are to provide reasonable assurance for the future. My fellow consultants will, I am sure, provide a number of well considered recommendations for specific technical fixes. I endorse nearly all of these, but most specifically those for the expeditious provision of remote shutdown capability and for a more survivable ECCS.

After the accident at Three Mile Island in 1979, and after the Challenger accident earlier this year, the President appointed an *ad hoc* committee, external to the Agency involved, to study the accident and to make the necessary recommendations. (It is interesting that the Soviets did the same thing after Chernobyl.) In each of these two cases, the Kemeny and Rogers Commissions, the group found and sharply criticized widespread complacency generated by a long period of accident-free operation. That was, in my view, the central problem at Chernobyl. I have found the same problem here. It is by no means universal, nor is it as pronounced as it apparently was at Chernobyl, but is sufficiently common to be cause for serious concern. Apart from its direct effect on the safety of the reactor, it can also affect the diligence with which one studies the problems. Wigner once said that there are three ways to approach a problem: to seek a solution, to prove that the problem is insoluble, or to prove that there is no problem. There is too much of the latter in the NUSAR, and it persists to a disturbing extent in some of the current internal reviews. Jefferson said that eternal vigilance is the price of liberty; that is also true of safety.

I regret to say that there was also evidence of complacency at the plant, at the lower levels. Admittedly, I have had only a short visit, so some of the observations may have simply been aberrations from the norm, but there were an uncomfortable number of small but significant deviations from familiar safety practice. The sense that came through was one of people doing a job in a context of safety rules whose significance had somehow been lost, and which were therefore not deemed very important. This was somewhat puzzling, since the upper management seemed well focused; yet the plant workers must somehow reflect the values passed on from above.

This is not as defamatory as it may sound. It is virtually impossible to maintain the necessary sense of insecurity and concern for the occurrence of improbable events, when everyday experience seems to belie the need. It requires constant attention to maintain a taut ship. Pilots have a similar problem, as do the Air Force personnel who man the missile silos, to say nothing of the vast majority of drivers. And it is still a problem in the nuclear industry, despite the Kemeny Commission report. Few humans will perform to the best of their ability, year after year, with only inspirational speeches to motivate them. I will have some suggestions below.

During recent decades there have been many serious incidents in commercial reactors, ranging from scram failures to fires, to control system failures, to human errors of commission and omission, etc. Most have been benign (all except Chernobyl, in terms of exposure of the public to radiation), and they have contributed to a base of operating experience which, if properly exploited (and therein lies another tale), can contribute mightily to our understanding of the vulnerabilities of those reactors. Because it is unique, the N reactor can benefit only in part from that operating experience, and I found little in the way of systematic effort to derive even those benefits. (The isolation of the N reactor community is a subject to which I will return.) Therefore, there is no way to understand the reactor-unique accident modes (such as an in-core pressure tube rupture), other than through theoretical analysis. I have no reason to believe that the analyses are not done well, but there is simply less assurance than there is in the commercial world that everything important has been considered. Even in that world, most serious incidents are surprises.

It is therefore commendable that the Department is sponsoring a PRA for the reactor, because that is a systematic way to uncover accident sequences that have not yet occurred, as well as to explore their potential consequences in some detail. It is my understanding that the current plan is to expand the originally intended scope of the PRA to level three, and I would strongly urge that that be done. While that should enhance our understanding of the possible events in the reactor, it is important that we not put too much faith in the detailed results of the study. Leaving apart the inevitable uncertainties in any statistical analysis of this sort (uncertainties which are revealed by the analysis, not, as some seem to think, created by it), the reasonably high quality of PRAs in the commercial field has been achieved by a small community of practitioners over years of experience with a particular class of reactors. In fact, one of the principal criticisms of PRAs, that they are necessarily incomplete, is best met by comparing them with operating experience. In the case of the N reactor this assurance is not available, so that the PRA has to be more properly compared with the first that was done on commercial plants, not with the current state of the art. Still, the PRA is the best way to go, and its value is at least as much in the fact that the performance of a PRA forces disciplined thinking about the vulnerabilities of the plant, as it is in the final results. It is important, for quality control, that the PRA also be subjected to peer review, outside the DoE family.

I have been unable to understand the management structure, top to bottom, that envelops the N reactor, and believe the line of responsibility to be too long and too tenuous. It resembles a family operation. Given the importance of direct management involvement to the safety of any reactor, as has been so often demonstrated in the commercial domain, this is not a small matter. It is not entirely clear to me where direct responsibility lies at DoE headquarters in Washington, since responsibilities for the product and for the safety are divided. In turn, it has to be said that the local Operations office, though manned by competent and conscientious people, appears to be only loosely coupled to Headquarters. Finally, at the end of the chain, there is the contractor. This is a balkanized arrangement which cannot but detract from safety, despite the best intentions and dedication (which I do not question) of all involved. Just the simple fact that Headquarters safety responsibility does not include shut-down authority is symbolic of Department priorities. Finally, there is no external peer pressure encouraging excellence of the entire structure.

Before 1975, when the AEC was split into NRC and ERDA (in my view an error similar to that which led to the breakup of the telephone company), commercial licensing and defense programs were housed under one roof, so that the standards tended toward uniformity, or at least comparability, for the two worlds. That ended and, rightly or wrongly, the commercial standards have become progressively tighter. I do not believe that the DoE has been able to keep up, largely because of its isolation.

I believe that the closed nature of the DoE community, and its loose coupling to the increasingly experienced commercial world, are central and fundamental problems, since we all need the incentive provided by peer judgment, to perform at our best. Even the interaction among your expert consultants has been beneficial. There are two options available to the Secretary which bear mention.

At the time of bifurcation of the AEC, the ACRS went with the NRC side of the house (along with the five Commissioners), leaving ERDA, and later DoE, without the review service ACRS had provided. Perhaps for this reason the Act specifically states that the Secretary of Energy may solicit help from ACRS directly, and this provides a potential avenue which few seem to have noticed. (I don't know of any case in which it has been done, though the law is clear.) I believe it would be constructive for the Secretary to ask ACRS to participate somehow in the medium term evaluation of the N reactor, whether through direct review or review of the PRA, or in some other way. This is a group of deeply involved supposed experts, not in the DoE family, who can be drawn on without involving the full paraphernalia of NRC itself. (I must reemphasize my apparent conflict in writing this paragraph. I don't believe I have a real conflict, but we live in a suspicious world.)

Another outside group that has been very beneficial in the commercial field is the Institute for Nuclear Power Operations (INPO), which was created after Three Mile Island to encourage and support operational improvements in commercial nuclear power plants. It is well respected and effective. I believe it would be worth while to ask INPO to conduct an operational review of the N reactor -- a job that could be done in a few weeks, I am told. Though I may be wrong, I believe that it is only a matter of asking, and the results could be extremely helpful to you. The internal reviews have resulted in almost a hundred recommendations for improvement, many operational. It would be useful to hear from INPO.

Finally, let me turn to the bottom line question of continued operation of the reactor, bearing in mind the early comments about risks and benefits. We are talking about perhaps the next three to five years, the period before graphite growth makes major rebuilding or decommissioning inevitable. Long before then a decision must be made either to commit to a new production reactor, to rebuild the N reactor, or to accept a reduction in the U.S. production capacity. Such matters go beyond the boundaries of our charter.

In the last analysis, we are dealing here with a very large reactor, without conventional containment but with a novel and unique (but unproved) confinement system, and with a number of possibly significant shortcomings, such as lack of remote shutdown capability, lack of hydrogen mitigation facility, a somewhat less robust ECCS than one would like, a complex management structure, etc. For such a situation one would like an especially solid demonstration that the likelihood of an accident sequence that challenges the late lines of defense of the reactor is unusually low, and such a demonstration has not been made.

It is sometimes argued within the Department that twenty-three years of operation without a major accident are ample evidence of what you yourself have called "an outstanding safety record". At the risk of being pedagogical (for a professor, it is compulsive), it is worth exploring the statistical significance of the record. (Recall, though the analogy is somewhat misleading, that a record of twenty-four successful shuttle missions was used by some elements of NASA early this year to justify the twenty-fifth.)

It is extremely difficult to calculate the probability of a major reactor accident, and even more difficult, for other reasons, to decide what probability is acceptable. In the commercial arena, the NRC has, after years of debate and indecision, just recently promulgated a safety goal, which includes a probability objective for core melt of less than one in ten thousand per reactor year. The goal for the probability of a major release of radioactivity is much lower, but the NRC is dealing with conventionally contained reactors, so that is less relevant. If your intent is to hold the N reactor to a comparable safety objective, then twenty-three years of operation are simply irrelevant. The probability of a major accident can simply not be inferred from such short operating experience. Three Mile Island happened after several hundred reactor-years of U.S. commercial experience, and Chernobyl after thousands of reactor-years of world-wide experience. On a *statistical basis* alone, a twenty-three year period of accident-free operation falls far short of providing the necessary assurance. Such assurance can only come from a competently performed PRA, and even then it will be beset with large uncertainties.

We were sometimes asked whether it is "safe" to operate the reactor for the next few years, and I have emphasized that that is an empty question. Those who ask it often have in mind a kind of dichotomy, in which it may be "unsafe" to operate it for (say) six years, but "safe" to operate it for three. In fact, whatever the probability per year of a major accident may be (and we don't know quantitatively), it is reasonably cumulative from year to year. Twice as many years entail roughly twice as much risk. There is no magic period which is devoid of risk. Therefore, any decision about the continued operation of the reactor must be made by balancing that (currently unknown) cumulative risk (and other costs) against the value of the product. One might argue that one can accept a higher level of risk in a single production reactor than one can in each of a hundred commercial reactors, but such an argument should be made openly, if at all.

An additional psychological point bears mention. During the Rogers Commission hearings on the Challenger accident, one of the major participants in the fateful discussions of O-ring reliability the night before the launch testified that "we were being put in a position to prove that we should not launch rather than ... prove that we had enough data to launch". It is important to avoid that frame of mind here too.

In the end, for all the reasons mentioned, I would recommend scheduling the permanent shutdown of the N reactor for the very near future, and concomitantly forcing a decision on a new production reactor. The requirements for special nuclear materials are, of course, largely controlled by matters outside the Department (for example, arms control negotiations or planned new weapons systems, to cite two opposite influences), but prudence would appear to dictate the need for an early decision. As you know, this has been an issue for years.

If you should decide otherwise, it is essential that the improvements recommended by my fellow consultants be implemented, with full awareness of the fact that too many changes at once can be antithetical to safety. The internal review teams must therefore provide priority lists for their own recommended changes. (Such lists may exist, but I have not seen them.)

Whatever your decision about the N reactor, I believe it important that the institutional issues that have been raised be addressed. The current structure is diffuse, encourages a defocusing of both safety responsibility and authority, and provides few weapons against complacency. These matters affect not only this reactor, but all the DoE facilities.

It has been a pleasure working with this distinguished and conscientious group, and with the capable and supportive staff provided by the Department. In particular, Marilyn Smith of DoE and John Ireland and Glen Graves of Los Alamos have been tireless and invaluable.

If any of the ideas presented in this short report need to be further developed, I would be happy (and obliged) to be of service.

Respectfully yours,

H. W. Lewis

DOE/RL 87-05

N REACTOR SAFETY ENHANCEMENT PROGRAM

SUMMARY DESCRIPTION

April 1987

U.S. Department of Energy
Richland Operations Office

N REACTOR SAFETY ENHANCEMENT PROGRAM

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1.0 INTRODUCTION

This report is a summary description of the Safety Enhancement Program (SEP) established by the Department of Energy (DOE) for N Reactor, located on the DOE's Hanford Reservation in Washington State.

Following the accident at the Chernobyl Nuclear Power Plant in the Soviet Union, safety reviews of N Reactor were accelerated and expanded, at the request of the Secretary of Energy, to include reviews by independent consultants as well as internal DOE reviews of the safety of operation of N Reactor. These safety reviews have produced recommendations that address the reduction of the probability of accidents and that provide increased assurance that outcomes from potential accidents are minimized with regard to the health and safety of workers and the public. The collection of activities that address these safety-related recommendations made during the above safety reviews constitutes the N Reactor Safety Enhancement Program.

The independent consultant reports and DOE internal reviews found that the same accident which occurred at Chernobyl is not possible at N Reactor. Notwithstanding this fact and the overall conclusion of these assessments that N Reactor does not pose an unacceptable risk to workers or the public*, the need for concerted action on the recommended design and operational improvements is recognized. With an objective to achieve even greater margins of safety, DOE has developed the N Reactor Safety Enhancement Program to assure that all appropriate improvements are accomplished.

At the conclusion of the N Reactor safety reviews, DOE, in exercising an abundance of caution, decided to place the reactor in a standdown condition at the next scheduled outage for refueling and maintenance. This was designed so that planned safety improvements could be performed in a more efficient and timely manner. Reactor "standdown" was initiated even though DOE had concluded that continued operation of N Reactor does not present an unacceptable level of risk to workers or the public. It is presently planned that the N Reactor will be operated at reduced power until the planned hydrogen mitigation equipment is operational to preclude fuel melting and hydrogen generation. The Department has advised the National Academy of Sciences of the Department's plans regarding hydrogen mitigation and continued operation of the reactor, and requested that the National Academy of Sciences specifically provide input on this subject.

*Two of the six independent consultants recommended that continued operation be predicated on the essential need for N Reactor in terms of national security. The DOE Under Secretary reaffirmed this need in a December 12, 1986, statement.

The following sections of this Introduction provide background information on N Reactor, results of recent safety reviews and discussion of the implementation of the Safety Enhancement Program. Sections 2.0, 3.0, and 4.0 of this document summarize the specific N Reactor SEP modifications, special technical studies and evaluations, and improvements in management systems and personnel training being implemented to further increase the margin of safety at N Reactor. It is noted that the changes will comply with DOE Orders and will be in accordance with uniform standards, guides, and codes which are consistent with those applied to comparable licensed reactors.

1.1 Chernobyl Accident Background

The N Reactor Safety Enhancement Program was developed to respond to findings of safety reviews performed by, or at the request of, DOE following the accident at Chernobyl. All of the internal and external safety reviews of N Reactor concluded that the same accident that occurred at Chernobyl can not occur at N Reactor due to a fundamental and critical design difference (see Section 1.3). Of key importance to this conclusion was that the Chernobyl reactor had a positive coolant void reactivity coefficient under certain operating conditions, while N Reactor (and other U.S. reactors) has a negative coolant void reactivity coefficient under all conditions. A positive coolant void reactivity coefficient means that when steam forms in the reactor, reactor power level increases, while a negative coefficient means the opposite (reactor power decreases).

Other analyses performed for the Department of Energy by a team of technical experts from the national laboratories (published as DOE/NE-0076, November 1986) concluded that the causes of the Chernobyl accident were as follows:

- The Chernobyl plant was placed in such an unstable condition that any event that resulted in a significant increase in the amount of steam in the reactor would have resulted in a damaging reactor power level increase called a "power excursion."
- The DOE expert team's analyses have confirmed the Soviet's claim that a reactivity excursion occurred and was caused primarily by increased steam formation due to overheating in the reactor when the coolant flow was reduced.
- The power excursion probably peaked significantly above 350,000 megawatts thermal (MWt), which is 100 times the normal full power of the Chernobyl plant.
- When the fuel failed as a result of the power excursion, a fraction of the fuel was forcibly ejected into the coolant causing extremely rapid formation of additional steam. This steam explosion destroyed the Chernobyl reactor.
- Improper operator actions at Chernobyl, which involved disabling

key safety systems, failure to follow procedures, and failure to have independent safety review of procedure changes, combined with the reactor instabilities (i.e., the positive coolant void reactivity coefficient) to allow the steam explosion to occur.

There was early conjecture that the Chernobyl accident was caused by or exacerbated by graphite burning and a zircaloy-water reaction that produced hydrogen causing a hydrogen explosion. There is no evidence that these phenomena had any significant impact on the consequences of the Chernobyl accident.

The detailed understanding of the accident provided by the DOE expert team's analyses resulted in an assessment of the potential for a Chernobyl type accident in the U.S. reactors. The expert team found that U.S. reactors are designed such that a large power excursion due to core instability from a positive coolant void reactivity coefficient is not possible. In addition, there are a number of basic design differences between the Chernobyl reactor and N Reactor that make their response to operating and emergency conditions markedly different. N Reactor's operating and emergency responses do not lead to the instability that the Chernobyl plant experienced. Significant differences include the following:

- N Reactor's control rods are used to control the nuclear reaction and shut the reactor down if necessary. N Reactor control rods are fully inserted in 1.5 seconds. The Chernobyl reactor required 20 seconds for full insertion.

- As a back-up to the control rod system, N Reactor has an independent, fully automatic, fail-safe backup shutdown system. This system will shut down the reactor within two seconds and does not require electrical power to operate. The Chernobyl Reactor had no fast-acting backup shutdown system.

- N Reactor has a negative coolant void reactivity coefficient for all of its operating range; therefore, the reactor power level will decrease should loss of cooling water or steam formation occur. The Chernobyl reactor was designed to have a positive coolant void reactivity coefficient; that is, if the amount of steam is increased in the reactor coolant, an increase in power level occurs. Furthermore, N Reactor coolant does not form steam in the reactor under normal operating conditions.

- The confinement system at N Reactor encloses the entire reactor and primary coolant piping. The Chernobyl confinement enclosed only the primary coolant piping. The top of the reactor core was not enclosed in the Chernobyl confinement structure.

Notwithstanding the absence of relevant similarities between N Reactor and Chernobyl, in accordance with its stated objective of pursuing safety excellence, the Department of Energy developed a Safety Enhancement Program to respond to the reviewers' recommendations and to obtain the greatest possible safety margins at N Reactor.

1.2 N Reactor Location and Description

The N Reactor is located in the north central part of DOE's Hanford Site in southeastern Washington State. The Hanford Site comprises some 570 square miles of semi-arid land. Cooling water for N Reactor comes from the Columbia River, which flows through the northern and northeastern part of the site.

There are no residences on the Hanford Reservation. The nearest inhabited residences are farm houses six miles northwest of the N Reactor. There are 35 residences within a ten mile radius of the N Reactor site, which is the normal emergency planning zone distance for commercial nuclear reactors.

N Reactor facilities occupy a 90-acre site on the southeast bank of the Columbia River within a 5 1/2 mile exclusion area. The Washington Public Power Supply System (Supply System) Hanford Generating Project, which uses by-product N Reactor steam to generate electricity, is located immediately adjacent to the N Reactor complex.

N Reactor fuel is slightly-enriched uranium, and the reactor itself is a pressure-tube type, light-water cooled, graphite-moderated reactor designed and operated to produce special nuclear materials at a power level of approximately 4,000 megawatts thermal (MWt). The excess steam produced by the plant is used to produce electrical power at the adjacent Hanford Generating Plant. The reactor core is a 1,800-ton graphite block approximately 33 feet by 33 feet and 39 feet long. A total of 1003 horizontal pressure tubes extend through the core. Perpendicular to the pressure tubes are 84 boron-carbide horizontal control rods which provide the neutron control, and the primary safety shutdown mechanism. Independent backup safety shutdown control is provided by the neutron absorbing ball safety system. The horizontal control rods and the ball safety systems were designed with sufficient speed to prevent fuel damage due to overheating and to keep the reactor in a safe shutdown condition.

In addition to the control and reactor shutdown systems, there are inherent safety features as part of the core design to prevent accidental excursions and to mitigate accident consequences in the event of an excursion-type accident.

A thermal shield surrounds the graphite moderator to intercept the radiation and heat energy that escapes from the reactor core. The thermal shield is surrounded by a biological shield which prevents the radiation activation of equipment in areas where operating personnel may be required for maintenance activities.

Because of the N Reactor design and the site location, safety analyses conclude that N Reactor conforms to Title 10, Code of Federal Regulations, Part 100 (10 CFR 100) guidelines using a confinement system rather than a containment-type system used in commercial light water reactors. The confinement system is designed to release the initial steam produced by a rapid loss of coolant pressure such as that which could be produced by a coolant pipe break. Because N Reactor is not allowed to operate with failed fuel, this steam contains only an inconsequential quantity of radioactivity. When the confinement pressure subsides, the steam vent valves close and the exhaust valves open to ventilate the reactor building through a set of high efficiency filters. This will establish a filtered release path prior to the release of fission products in the unlikely event that a fuel element failure occurs.

If a primary coolant pipe break should occur, N Reactor has an Emergency Core Cooling System (ECCS) to provide a separate, independent water supply for emergency once-through cooling of the reactor. The ECCS is intended for use only if the normal recirculating water heat removal system is disabled by a major break in the reactor coolant system piping. The ECCS is designed to prevent fuel failures in the unlikely event of major pipe breaks.

N Reactor also has a unique third level cooling system, called the graphite and shield cooling system. This system aids in cooling the graphite during normal operation; most of the heat is removed by the primary coolant. In the unlikely event of a major pipe break and a total failure of the ECCS, this system alone is sufficient to limit core melt and subsequent fission product release to below the safety guidelines presented in 10 CFR 100.

1.3 Chronology of the Recent N Reactor Safety Reviews

Following the Chernobyl Reactor accident, new safety reviews of N Reactor were undertaken at the request of the Secretary of Energy and planned safety reviews were accelerated and expanded. Three safety reviews were conducted under the direction of the DOE's Assistant Secretary for Environment, Safety and Health. Independent reviews were also conducted by the General Accounting Office (GAO), a group appointed by former Governor Atiyeh of Oregon, six expert consultants (the Roddis Panel) commissioned by the Secretary of Energy, and lastly, the National Academy of Sciences (NAS) and the National Academy of Engineering (NAE). In the past year, N Reactor has been examined by seven safety reviews comprised of 51 expert reviewers.

A chronology of the safety reviews and subsequent reports follows:

o In May 1986, at the request of the Secretary of Energy, a Special Safety Review Team, convened by DOE's Assistant Secretary for Environment, Safety and Health (ASEH), conducted evaluations of the fire protection systems for the graphite moderator and of the safety of the N Reactor confinement system. Results of this review are included in a report released in May 1986, "Report of the Special Safety Team Review of N Reactor (Graphite and Confinement Issues)."

- A DOE Technical Safety Appraisal of N Reactor, one of a series of such reviews of DOE facilities being performed under order of the Secretary of Energy, was conducted under the authority of the ASEH between May 1986 and June 1986. This Technical Safety Appraisal was a multi-disciplined review covering all aspects of the operation of N Reactor. Results of this review were documented in DOE/EH-015, "Technical Safety Appraisal of the N Reactor, June 1986."

- From May 1986 through July 1986, a Design Review of N Reactor was conducted by a DOE team of experts at the request of the Secretary of Energy. This review, performed under authority of the ASEH, examined the plant systems that are the most important in preventing release of radioactive materials in the event of major equipment failures and/or human error. The results of this review are documented in DOE/EH-017, "Design Review of the N Reactor," dated September 1986.

- A committee from the GAO visited N Reactor in June 1986. Representatives from the Oregon Department of Energy also participated in this visit. The GAO issued its report in August 1986, (GAO/RCED-86-213BRC). The state of Oregon Appraisal Report was also issued in August 1986.

- In May 1986, the Secretary of Energy appointed six individual consultants to "assist the Department by ensuring that we have examined all of the key technical questions and probed into the safety issues raised by the Chernobyl Accident" as they may relate to N Reactor. Each consultant provided an individual report which was released by DOE in December, 1986.

- The Secretary of Energy requested that the National Academy of Sciences (NAS) and the National Academy of Engineering (NAE) make an independent safety assessment of DOE's major production and research reactors including N Reactor. These reviews began in December 1986, and the recommendations will be incorporated into the SEP when made available by the NAS/NAE.

Based upon and following evaluation of the available reports and recommendations of the above N Reactor Appraisal Teams, the DOE concluded that the N Reactor does not pose an unacceptable risk for continued operation, and it could not have the same accident that occurred at Chernobyl. DOE decided that actions could and should be taken on the recommendations to further enhance the N Reactor's margin of safety.

On December 12, 1986, DOE announced its decision for standing down N Reactor by extending the refueling and maintenance periods scheduled to start on January 7, 1987, and provided additional funding to accelerate completion of many of the recommended actions ahead of the previously defined schedule.

This Safety Enhancement Program responds to the recommendations of the appraisers regarding the prevention of accidents and mitigation of their consequences. Recommendations dealing with normal N Reactor maintenance and operation that do not directly affect reactor safety are not a part of the Safety Enhancement Program. The responses to all recommendations are being tracked by DOE with detailed programmatic documentation which assures adequate response to each of the comments.

Recommendations addressing overall DOE policy issues that are relevant to DOE-wide reactor safety are being addressed by the Department's Office of Environment, Safety and Health directly. These include recommendations made by the six individual consultants that greater use be made by DOE of the Advisory Committee on Reactor Safeguards (ACRS) and the Institute of Nuclear Power Operations (INPO). Other concerns raised by the consultants included the assignment of organizational safety responsibilities within DOE, the need for a standing safety oversight group, and a comparability with commercial licensed reactor practice. The continuing need to combat institutional complacency, a recommendation of several independent consultants, is being addressed both through consideration of expanded external reviews (e.g., ACRS or INPO) and personnel training described in the SEP for N Reactor. As noted by the Under Secretary in his December 12, 1986, statement on the planned standdown, these and other policy issues are under review by the Department and a course of action will be decided once the results of the NAS/NAE review are available to DOE. Because of their DOE-wide signficance, these broad policy issues are not addressed in the N Reactor SEP.

The Safety Enhancement actions presently being taken are grouped into three broad areas affecting reactor safety, with emphasis on prevention of serious reactor accidents and their mitigation. These areas are:

1. Plant modifications designed to improve the ability of plant safety systems to prevent or mitigate serious reactor accidents (Report Section 2.0).

2. Technical studies and evaluations of reactor performance to understand more completely the mechanisms by which low-probability accidents might occur. The results of these studies may possibly result in recommendations for additional plant modifications (Report Section 3.0).

3. Personnel training and administrative changes to provide both heightened awareness and enhanced responses to severe and extremely low probability reactor accidents. (Report Section 4.0.).

2.0 PLANT MODIFICATIONS

The N Reactor Safety Enhancement Program includes the seven plant modifications discussed in the following sections that have been accelerated to further enhance N Reactor safety margins. Most of these enhancements were previously planned in the ongoing comprehensive N Reactor safety program. All of the modifications are designed either to further decrease the already low probability of accidents, or to further reduce the consequences of such events should they occur.

2.1 Control Room Habitability

The primary reactor control center (room) is continuously staffed by certified operators trained to monitor instrumentation, make routine adjustments to plant operating processes, and be prepared to back up automatic safety features by taking decisive actions in the event of an accident.

Currently, the N Reactor control room ventilation system uses outside air that is filtered and either heated or cooled by a single air handling unit before being routed through ducts into the control room. Air from the control room is then exhausted into the electrical relay room beneath the control room through floor-mounted exhaust fans. Most of the air reaching the relay room is returned to the air handling unit through a ceiling damper. The remaining air is exhausted through an electrical switchgear room. Isolation of control room ventilation, if necessary, would be accomplished by automatic closure of the outside air inlet and exhaust dampers, manual shutdown of the exhaust fans, and recirculation of the control room air by the same air handling unit through the pathways described.

The upgrades to the N Reactor control room will provide protection for up to ten control room operators for seven days in the event of a low-probability accident. Such an unlikely event might involve natural phenomena such as earthquakes, tornadoes and volcanic eruptions, and the release of airborne radioactive materials and water treatment chemicals (e.g., chlorine and ammonia). Although the air within the control room could be recirculated and filtered, since the existing control room air pressure is not higher than that of surrounding areas, the breathing air could become contaminated by released radionuclides or chemicals. The control systems will automatically shut down the reactor in the event of an accident and, if necessary, will automatically initiate engineered safety features to prevent or limit any fuel damage. Cooling systems are designed to cool the reactor without any operator action for a minimum of seven days. However, safety could be enhanced by allowing operators to remain in the control room for monitoring and adjustments. Although the operators currently could remain in the control room by using available self-contained breathing apparatus in the event of a serious accident, it was decided that the control room habitability should be enhanced. This 1985 project is being expedited under the SEP, and construction will be completed in December 1988.

The N Reactor control room habitability upgrade will provide an air handling system with dual emergency air intakes (one local and one remote intake), high efficiency in-line filtration and sufficient capacity to pressurize the control room to prevent inleakage of contaminated air. The new ventilation system will be used solely for the control room. Both radiation and chemical gas monitors, together with high efficiency filters, will be provided on the emergency and normal air intakes. In the event of an accident or material release, automatic isolation of the normal control room air intake and realignment of the ventilation system will occur by means of a new damper arrangement. Electrical power for ventilation system operation will be provided by the two existing independent power sources. Should these power sources fail, the ventilation system would automatically receive power from a new on-site emergency diesel generator dedicated for this purpose. All emergency ventilation system components and other components required for control room habitability will be constructed to meet seismic and tornado protection requirements. The control room structure will also be upgraded to provide increased tornado missile protection and additional radiation shielding. Control room operators will also be provided with supplies adequate to serve up to ten people for seven days. These supplies will be seismically secured and stored within the existing control room or in accessible seismic- and tornado-protected rooms.

2.2 Emergency Core Cooling System (ECCS) Upgrade

This section describes the planned safety enhancements of the N Reactor Emergency Core Cooling System which increase the water supply capabilities and add to the existing pumping system's redundancy.

2.2.1 Increasing Water Sources and Pumping Capabilities

The N Reactor ECCS is a once-through reactor cooling system. The ECCS is an engineered safety system designed to ensure adequate fuel coolant for any reasonably conceivable event. It draws water first from the plant's water storage tanks, and then, if necessary, directly from the Columbia River. The system will start automatically in the event of a loss of normal cooling water and will not require operator attention for seven days of operation.

The existing ECCS uses two stages of multiple, redundant, direct-drive, diesel-powered pumps that force the cooling water through the reactor. The system has sufficient redundancy to allow for active component (pump) failures. The ECCS is tested routinely and rigorously. It has not been necessary to utilize this system since the initial startup of N Reactor in 1964.

However, DOE is increasing the redundancy and reliability of the ECCS System. The planned ECCS water source and pumping capability enhancements would provide a second fully independent ECCS. This plan includes construction of a new water storage tank close to the reactor and a connection to 50 million gallons of water stored in two existing basins 6.5 miles from N Reactor. Another direct-drive, diesel-powered pump and fuel supply will be added to ensure delivery of the water to the ECCS piping. This water storage and pump addition will be sized to meet the cooling requirements of the reactor in the event of concurrent failure of both the normal cooling water system and the current ECCS.

Following reactor cooldown, the water needed to maintain cooling would be provided by an independent water supply that would be tied into the ECCS. This water would be pumped from either of two existing 25-million gallon storage basins. These two basins are currently fed from the Columbia River by electric motor-driven pumps, and one of the two is backed up by direct-drive diesel-powered pumps. Thus, the new system, comprised of stored water at 100-N Area and the 50-million gallons in tanks away from N Area, will provide both independent water source availability and pumping redundancy for reliable reactor core cooling in the extremely low probability event of a failure of the current ECCS water supply system. Design of the tie-in to the two 25-million gallon basins is underway and construction is scheduled for completion by November 1987. Construction of the new water tanks and pumps is scheduled for completion in May 1991.

2.2.2 Enhanced Separation of ECCS Components

The existing N Reactor ECCS has two groups of diesel-driven pumps operating in series to provide emergency cooling water. The first pump group, the low-lift diesels, takes water from the Columbia River and supplies it to the second pump group, the high-lift diesels, for injection into the supply side of the reactor coolant system.

Fire protection for the diesels is provided by water spray systems which operate automatically upon heat detection to deluge simultaneously all engines in the same pump group. Water spray on the diesel engines would not stop engine operation. One diesel engine in each pump group is currently separated from nearby engines by a concrete block wall. The other diesel engines in each pump group are separated by corrugated metal barriers. Since the start of plant operation in 1964, there have been no fires involving these components.

Engine control and performance with the existing configuration of electrical control circuits have been very reliable. However, the electrical control circuits for the high-lift diesels are close together inside the building where they are housed.

Design changes are underway to provide enhanced separation and fire protection for the ECCS components. Higher, wider fire resistant walls will be built to physically separate the adjacent engines at both pumping stations. Master control valves in the existing deluge water spray system will be replaced with an individual valve and an automatic detection system for each engine's spray nozzle array. This independent protection feature will eliminate the possibility of drenching units other than the one that might be affected. The physical separation of electrical control circuits for the engines will be enhanced to better meet the current nuclear safety standards of the Institute of Electrical and Electronic Engineers (IEEE) for separation and isolation. The changes include circuit waterproofing. Construction will be completed by July 1, 1987.

2.3 Remote Reactor Shutdown Capability

A remote reactor shutdown control capability now being installed will provide the operating staff with the capability to shutdown the reactor independently from the control room, as well as to provide the ability to monitor critical plant systems and to verify the shutdown status. The panel operator will be capable of both rapid shutdown of the reactor and activating the ball safety system in a single operation. The ECCS supply and exit valves will also be activated by a single operation.

Suitable space within the N Reactor building, but remote from the current control room that meets all the required environmental, seismic, and security requirements for the remote shutdown panel has been identified. Heating and cooling of the room are provided by the existing building ventilation system, and a Halon 1301 fire protection system is installed. Access to the room will be limited to authorized personnel who will be monitored by site security for admission. A dedicated communication system will be provided with direct lines to the emergency response facilities (see Section 2.4), the existing control room, pump houses, and the standby power house.

Electrical power sources for the remote shutdown room will be independent from the control room power sources and will be of equal reliability to the normal control room power sources. The control circuits are routed from locations outside of the control and electrical relay rooms where possible.

The control circuits that do route through the control or electrical relay rooms are designed to be fail safe. The system has been designed and qualified such that equipment failure in the remote shutdown room will not prevent normal control room functions. Qualification of all control circuit components will comply with IEEE standards. This modification is scheduled to be complete and fully operational by July 1, 1987.

2.4 Emergency Control and Operational Support Center Upgrades

In the event that an accident occurs at N Reactor or appears imminent, three additional emergency response facilities which would supplement the existing emergency support facilities are planned: 1) the Emergency Control Center (ECC), 2) the Technical Support Center (TSC), and 3) the Operational Support Center (OSC).

In order to be consistent with the emergency preparedness standards for commercial nuclear reactors, the ECC and TSC require radiological protection for continuous habitability during severe accidents, along with adequate communication links and other required emergency equipment and supplies. The OSC, on the other hand, does not require radiological shielding and specially filtered breathing air protection, but does require modern communication links with the control room and the TSC, surplus supplies such as plant diagrams, emergency procedures, manuals, self-reading dosimeters, and other provisions to enable the staff to better manage a serious accident.

2.4.1 Technical Support Center (TSC)

The TSC is an emergency facility where predesignated technical, engineering, and plant management representatives assemble for the purpose of providing the additional management and technical expertise required to prevent an accident or to minimize its consequences. This location must meet the same habitability requirements as the control room. A dose assessment computer and direct lines from the TSC to the OSC and ECC will be added. Other required upgrades are included as part of the control room habitability project (see Section 2.1 above). The TSC will be completed by December of 1988.

2.4.2 Emergency Control Center (ECC)

The ECC is a facility remote from the N Reactor site that will be used for overall management of emergency response, including coordination with the DOE's Richland Operations Office. Its habitability requirements are similar to those of the TSC. A recently (1982) decommissioned, underground, DOE-owned emergency command center has been reactivated as the N Reactor ECC.

By July 1, 1987, enhanced voice and data communications plus habitability improvements for the ECC will be completed. An emergency diesel generator will be operable by September 30, 1987.

2.4.3 Operational Support Center (OSC)

Should an accident occur, teams composed of plant craftsmen, operators, and radiation technicians would man the Operational Support Center facility and take coordinated actions to prevent or minimize the consequences of such an event before fission product release begins.

The area selected for the OSC is the recently-completed N Reactor outage center. This location is ideally suited for an OSC since it provides comprehensive communications within the N Reactor facility and is in close proximity to the reactor control room. No additional construction or modification was required to establish the OSC. Administrative controls, procedures, and communications links are being finalized, and the OSC will fully operational on July 1, 1987.

2.5 Hydrogen Monitoring and Mitigation

One of the concerns during the Three Mile Island (TMI) accident was hydrogen gas generation within the containment. At N Reactor, no hydrogen generation could occur unless a loss of coolant accident occurs, the ECCS fails to operate, and then cooler water is introduced to the hot reactor core. Consequently, the simultaneous occurrence of several unlikely events would be required for any hydrogen to be generated.

The 1978 N Reactor Updated Safety Analysis Report (NUSAR) analyzed the consequences of hydrogen release to the confinement system. The NUSAR analysis concludes that the hydrogen releases to confinement, if adequately mixed, would not reach the lower hydrogen flammability limit because of the large N Reactor confinement volume and the continuous filtered release operating mode. This has been confirmed by more recent analyses. However, the SEP will provide added margin against hydrogen accumulation, with plant modifications to provide equipment to monitor for hydrogen and prevent flammable mixtures of hydrogen and oxygen. The following two sections address current plans to achieve the hydrogen monitoring and mitigation capability.

2.5.1 Hydrogen Monitoring

If any hydrogen were to be generated, it could accumulate only in confined spaces. These spaces will be monitored for hydrogen and oxygen. To provide adequate coverage for confined spaces and the balance of confinement, hydrogen monitoring equipment is being installed in the following areas:

- front and rear face reactor spaces
- pipe gallery space
- space surrounding the primary coolant pressurizer
- six steam generator cell spaces.

Twenty sampling points in the above named spaces will be used for redundancy. This monitoring system will remotely measure the concentrations of hydrogen and oxygen at each of these locations. The system will be used by reactor operators to evaluate the presence of hydrogen and the effectiveness of mitigation actions. While this system would not be required for the accidents analyzed in the safety analysis report, it would provide additional monitoring capability for unforeseen events.

The monitoring device being considered for use at N Reactor meets current commercial standards. It provides real-time monitoring for both hydrogen and oxygen. The hydrogen and oxygen sampling/monitoring system is currently under construction and will be operational by July 1, 1987. The system will employ two identical and redundant monitoring systems. The monitoring systems will draw samples from each of the designated confinement system volumes, analyze for hydrogen and oxygen, and exhaust the sample air back into confinement. The monitoring data will be displayed in the N Reactor control room. All controls needed to operate the system will be accessible from the control room. System components will be fully qualified to function in the temperature, pressure, and radiological conditions projected for the hypothetical accident. In addition, the system will be seismically designed to ensure function following an earthquake.

2.5.2 Hydrogen Mitigation

The purpose of the hydrogen mitigation system is to prevent the occurrence of flammable gaseous mixtures of hydrogen and oxygen. Several alternative mitigation concepts have been or are currently being evaluated. These include the following: 1) either pre- or post-accident purging of the containment atmosphere and replacement with nitrogen, an inert gas, with or without controlled venting and filtration, 2) forced mixing of air between the reactor building and steam generator building, 3) controlled burning by use of ignitors, and 4) recombining hydrogen with oxygen by means of thermal, flame, or catalytic devices.

Although the study of all alternatives is not completed, a combination of forced mixing, controlled exhausting, and post-event nitrogen purge/inert currently appears to be the most promising concept. Forced mixing between the reactor building and the steam generator building atmospheres would reduce the possibility of local accumulations of hydrogen. A controlled, filtered exhaust would maintain the pressure in the confinement system below that of the outside atmosphere and would vent the hydrogen through charcoal and high efficiency filters from the building. Post-event nitrogen purging could provide an additional margin of safety by guarding against long-term hydrogen accumulation in confinement.

Installation of the hydrogen mitigation system is scheduled for completion by December 1987.

2.6 Plant Emergency Warning/Annunciation Upgrade

Rapid alarm annunciation and/or voice communications at the onset of abnormal or postulated emergency events can be important both to alert plant personnel to possible hazardous conditions and to assemble and dispatch the operating and maintenance staffs to correct the conditions that could lead to hazardous events. N Reactor, like most commercial nuclear power reactors, has six ways to alert workers to such events: 1) local zone radiation alarms, 2) local area/building fire alarms, 3) plant-wide evacuation alarms, 4) a public address system, 5) paging devices, and 6) emergency accountability procedures that provide verification that all personnel are accounted for and are aware of any real or potential emergency.

System enhancements were identified as increased area coverage by evacuation alarms, local fire alarms, and the public address system. An in-depth evaluation of these three systems was conducted by the N Reactor staff. Enhancement actions have been defined, implemented, or are planned. All enhancements will be completed by July 1, 1987.

2.7 Liquid Effluent Retention Facility (LERF)

Although N Reactor currently complies with DOE and comparable NRC Reactor Site Criteria (10 CFR 100) with respect to population doses that could result from a postulated major accident, it is the intent of this enhancement to increase safety margins by making improvements to N Reactor's emergency liquid retention basin.

An emergency retention basin is utilized to receive the radioactive liquid effluent in the event of an accident.

Under the Safety Enhancement Program, the existing emergency retention basin capacity will be increased from 5.5 million gallons to 11.2 million gallons. The basin will be double-lined to enhance protection against potential radionuclide migration into the groundwater, and it will also be provided with a cover to minimize release of radioiodine to the atmosphere. A leak detection and collection system will be installed to monitor liner integrity. Provisions will also be established to provide an annual inspection of the cover. These modifications are designed to contain about 95% of the liquid-borne radioiodine anticipated to be released during a low-probability accident.

Upon detection of accident conditions, flow of radioactive emergency cooling water will be automatically delivered to the new lined liquid effluent retention facility. When the capacity of this lined retention basin is reached, passive initiation of flow to the normal waste disposal facility via a newly-constructed bypass will occur. This bypass will only be used following retention of the accident waste within the lined basin.

New valves, including those required to isolate the system for maintenance, will be installed in existing lines to direct flow into the lined retention basin upon ECCS actuation. Annunciation will be provided in the N Reactor Control Room for valve operation, low temperature warning (for freeze protection), and low pressure warning (valve actuating devices). Indications to show water level in the lined retention basin will also be provided. Control room remote operation and local operation of the valves will also be provided.

Groundwater monitoring wells will be installed on the river side of the retention lined basin to monitor radionuclides in the groundwater should an accidental release occur and the basin malfunction.

Mobile waste treatment equipment would be used for cleanup of retained liquid in the lined basin. This upgrade is scheduled to be completed by July 1, 1987.

3.0 TECHNICAL STUDIES/EVALUATIONS

This section describes technical studies and evaluations currently being conducted as part of the N Reactor SEP.

3.1 Confinement System Testing

N Reactor's confinement system was designed to prevent overpressurization during an accident and confine fission products inside the reactor building in the unlikely event of massive fuel failure. Following a low-probability major coolant pipe break, steam released from the reactor coolant system is vented to atmosphere through normally open steam vent valves that are sealed for normal operations with weather caps. Calculated maximum confinement pressure is about 4.2 psig. Automatic fog sprays actuate to condense the steam, further reducing the pressure. In this way the confinement pressure would rapidly decrease to a pressure slightly above atmospheric. The large vent valves would close and the fog sprays would continue to cool the resealed confinement. The sequence is fast enough to reseal the confinement before any fission products are released from the fuel.

In the hypothetical case in which the emergency cooling system also fails, uranium fuel would heat up, fuel cladding failures would occur and fission products could be released to the confinement system. The already resealed confinement system would be operating at a slightly positive pressure. Releases of radioactivity to atmosphere would occur through the activated charcoal and high-efficiency particulate air filters. The filters significantly reduce the quantity of the fission products released. This system improves public protection by keeping dose commitments from such accidents below that required by DOE requirements and comparable Nuclear Regulatory Commission standards for commercial light water reactors.

The concrete confinement structure contains sealed penetrations through which piping and electrical leads pass. The N Reactor confinement system is designed to operate in such a way that confinement penetrations would not be subjected to high pressures when fission products are present. Included in this task is testing of confinement components at pressures somewhat higher than atmospheric to assure their ability to subsequently maintain sealing capabilities upon fission product release into the confinement. Enhanced tests, and other related studies described below, have been established to further ensure that the confinement system will operate as designed or better. Completion of the six identified tasks is scheduled by July 1987, including any modifications to the system that might be determined to be appropriate.

3.1.1 Test Confinement Seals

This task will pressure test a statistically based number of confinement system penetrations. The sample penetrations will be subjected to the maximum calculated blowdown pressure; this test will be preceded and followed by a low-pressure leak test. This will demonstrate that the penetration seals are not compromised by peak confinement pressures. The test will verify the confinement penetration integrity at the low pressures during which fission products are released. All penetrations not tested in the original sampling will be tested over a period of several years.

3.1.2 Test Confinement at Higher Pressure

Integrated leak rate testing of the N Reactor confinement has been routinely conducted somewhat above the filtered release mode pressure. Higher pressure testing of the confinement system will be conducted to provide enhanced assurance that design requirements will still be met following exposure to pressures typical of a serious accident. The response of the confinement system instrumentation will be monitored to verify proper response of subsystems and instruments. The impact of the test pressure cycle on the filtered release leak rate will be determined by conducting a low pressure leak test both immediately before and after the pressure transient is applied. This test will also be based on Nuclear Regulatory Commission standards.

3.1.3 Protect Steam Vent Valves From Debris

The susceptibility of the N Reactor confinement steam vent valves (which vent high pressure steam from postulated pipe break) to blockage from the potential effects of debris will be evaluated.

Analyses using current methodology will provide velocity profiles for the steam during low-probability accidents. The analyses will determine the potential for the steam to carry debris into the steam vents and the resulting potential impacts on the designed operation of the valves. Should any potential impacts on the operation of the valves be found, they will be scheduled for corrective action based on a risk assessment of the consequences.

An earlier investigation revealed the need to strengthen a cable tray in close proximity to a steam vent valve opening. This task will also ensure satisfactory completion of the cable tray structural upgrade.

3.1.4 Ensure Sensing Line Block Valve Lineup and Control

The confinement sequence (fog spray actuation, steam vent valve closure, heating and ventilation shutdown, etc.) is initiated by increased pressure within the confinement. Sensing lines from various confinement locations are routed to pressure switches located outside of the confinement. A block valve is provided between the switch and the open sensing line to permit periodic calibration of the switches as required by technical specifications. More stringent control requirements will be established to ensure proper lineup and control of the block valves because of their critical importance to confinement system operability. The existing controls will then be compared to the requirements. Should any discrepancies be found, they will be corrected by plant modifications and/or administrative system upgrades.

3.1.5 Determine Hydrogen Iodide Decontamination Factor

Efficiency testing of the N-Reactor confinement system halogen adsorbers does not presently include testing for hydrogen iodide removal. Tests will be conducted according to established American Society for Testing and Materials (ASTM) procedures using best estimate concentrations of hydrogen iodide for the hypothesized N Reactor accident. The filter system will be tested at concentrations which will meet or exceed the best estimate of the hydrogen iodide concentration. Filter heat loadings will be reviewed to ensure that captured iodines are not released. Dose calculations to workers and the public will be reviewed to estimate the impacts of dose commitments produced if an accident occurs.

3.1.6 Avoid Contamination Via Cooling System Interconnections

Certain penetrations of the reactor containment structure at the Three Mile Island plant proved to be inadequate to maintain containment because of leakage. This inadequacy was responsible for the major fraction of the TMI accident's environmental releases. Criteria for proper isolation of cooling systems components that penetrate N Reactor's confinement will be re-evaluated against the Three Mile Island experience and the current Nuclear Regulatory Commission General Design criteria. Isolation will be provided for any lines that may not presently meet the criteria.

3.2 Pressure Tube and Graphite Analysis

N Reactor has a formal evaluation program which monitors and analyzes the pressure tubes and the graphite. Based on the evaluation program results, the characterization and projection of future trends for these components have been routinely and rigorously accomplished and documented. Differences from the expected conditions were investigated. The results of on-going studies on both pressure tubes and graphite provide continuing assurance that operations are conducted consistent with the specifications of the components. The graphite has recently had additional intensive study, since its changing condition could potentially limit the operational life of N Reactor.

The following sections describe the pressure tube and graphite evaluation program, which now incorporate some accelerated evaluations.

3.2.1 Pressure Tube Analysis

The program to evaluate the integrity of the pressure tubes for the purpose of determining duration of useful life consists of the following: 1) removal and examination of selected tubes, 2) in situ surveillance, 3) accelerated irradiation testing, 4) hydrogen effects testing, and 5) analysis. Through 1986, nine pressure tubes had been removed from N Reactor and characterized for metallurgical properties important to safety and continued serviceability. These characterizations included visual inspection, hydrogen content measurement, and mechanical property testing including some burst tests. Using the data obtained, projections were made of the safe life expectancy of the tubes. In addition, several studies were conducted on tube seismic adequacy.

The N Reactor SEP has expanded the pressure tube data collection and analysis effort to provide an enhanced basis for predicting future pressure tube integrity. During the January-to-July 1987 standdown, four pressure tubes are being removed for examination, and 60 to 100 tubes will undergo extensive in situ nondestructive examinations (NDE). The NDE results, along with the data obtained from the four tubes removed, will be used to improve the accuracy of predicting pressure tube service life.

Other analyses and testing are also planned. These include additional evaluation of the potential for pressure tube failure, the impact that a failed graphite cooling system tube could have on the pressure tubes, and an accelerated irradiation test program to provide more extensive pressure tube material property data. In addition, elevated hydrogen concentrations will be artificially induced into samples of pressure tube materials to determine the material properties under such conditions.

Following 1987, two pressure tubes will be removed each year for at least the same tests as will be conducted with the tubes removed in 1987, and in situ NDE tests and measurements will be made on other pressure tubes.

3.2.2 Graphite Analysis

The program to manage the graphite growth consists of the following: 1) surveillance, 2) modeling consequence analysis, and 3) flux flattening (a method to control graphite growth). Surveillance has been conducted since the initial startup of N Reactor in 1964. It includes surveillance through horizontal reactor control rod channels, vertical ball safety channels, untubed channels, and special channels. Graphite specimens have been periodically removed and evaluated to assess oxidation. Accelerated graphite irradiation tests were performed in the Oak Ridge High Flux Isotope Reactor (HFIR) facility in the late 1970s to establish graphite contraction and expansion data. Additional graphite samples have been irradiated in the HFIR, and will be analyzed as part of this task. These efforts have all contributed to the graphite distortion modeling under reactor in-core irradiation conditions.

With the advent of the SEP, increased emphasis has been placed on graphite evaluation. In addition, neutron flux flattening will be used to significantly slow projected distortion. In-core neutron flux monitoring, in combination with revised fuel load patterns, will accomplish this. Tooling is being developed to provide profile measurements on control rod channels, graphite cooling system tubes, and ball channels. In-core monitoring equipment is being added to provide detailed graphite motion data. Testing of the top thermal shield components is being performed to more precisely predict the sequence of events as graphite growth occurs. The program will supplement the use of existing equipment to provide visual and physical graphite measurements.

Data obtained from the additional studies will be used to confirm and improve the graphite distortion model. The technical bases used for all such analyses will be documented so that future life projections can be refined as more comprehensive data become available.

3.3 Equipment Qualification

An Equipment Qualification Program (EQP) similar to that required for commercial reactor plants has been initiated for N Reactor. The EQP will augment existing information available on those safety-related system components that are required to operate in order to minimize the consequences of a reactor accident. The EQP backs up the design bases by assessing the operability of components under accident conditions. Currently, the N Reactor subscribes to the equipment qualification database published by the Electric Power Research Institute (EPRI). This information will provide input to the total EQP, along with the standards and codes used by the nuclear industry. The basic elements in establishing this enhancement are covered in the sections below.

3.3.1 Equipment Qualification Program Plan

An EQP plan will be developed to identify a program scope which utilizes the relevant commercial nuclear reactor codes/standards as N Reactor requirements. The N Reactor component and design records, including the safety analysis, will be used as source information for development of the EQP plan. The plan will contain lists of the equipment in the safety related systems, along with the required environmental and seismic qualification conditions. The EQP plan will be completed by June 30, 1987.

3.3.2 Equipment Testing and Analysis

Procedures for analyses, comparisons, and tests will be developed. Qualification of the identified components will be conducted and files on the results established and maintained. This work will begin in July 1987 and be completed by September 1988.

3.3.3 Maintenance Considerations

The final step in the EQP is to compare the qualified equipment against the current maintenance procedures and practices, including updates of the spare-parts inventories. This will provide assurance that all components that have been qualified will remain so. This will be completed by August of 1989 and as new components are procured and installed during maintenance upgrades.

3.4 Probabilistic Risk Assessment (PRA)

Probabilistic risk assessments have been used on a number of commercial reactors to provide an additional perspective of reactor safety and to provide additional input into the planning process for improving safety margins. A review of methods and technology for a PRA of N Reactor was initiated in 1983.

The enhanced PRA program covers assessments of plant risks that require estimates of both the probabilities and consequences of postulated N Reactor accidents. The three-level program contains the following work packages:

- Level 1: Analysis of plant design and operation focused on the frequency of accident sequences that could lead to postulated core-damage or loss of plant availability.
- Level 2: Analysis of the physical processes of the postulated core-damage accidents and the response of the confinement system. Predictions of the time and mode of radionuclide release as well as

inventories of radionuclides released to the environment will be determined for the dominant accident sequences.

- Level 3: Analysis of the public health and economic consequences of postulated N Reactor accidents.
- External Events: Analyses of the effects of earthquakes, seismic events, floods, fires, etc. on N Reactor.

A Level 1 PRA was initiated for N Reactor in October 1985. The Level 1 program will be expedited and expanded to Level 3, including analyses of external events.

For the PRA, a number of reactor analysis computer codes currently used in the evaluation of commercial light water reactor safety are being modified for application to N Reactor. As part of this code modification, physical models of N Reactor material behavior require development. Examples of these include fission products release from metallic fuel and molten uranium interaction with zircaloy in a steam environment.

Once the initial PRA support tasks have been completed, the analysis program will be maintained for continued use at N Reactor.

The Level I PRA focuses on a determination of the frequency of accident sequences that could lead to core damage or loss of plant availability. It will be expanded in scope and accelerated to effect completion in 1987.

The Level 2 and 3 PRA work is extensive and is being conducted by the Sandia National Laboratory. This work will be completed in 1988, with a draft by September 1988.

Figure 3.4.1 provides a simplified flow diagram of the steps involved in the performance of a Level 3 PRA.

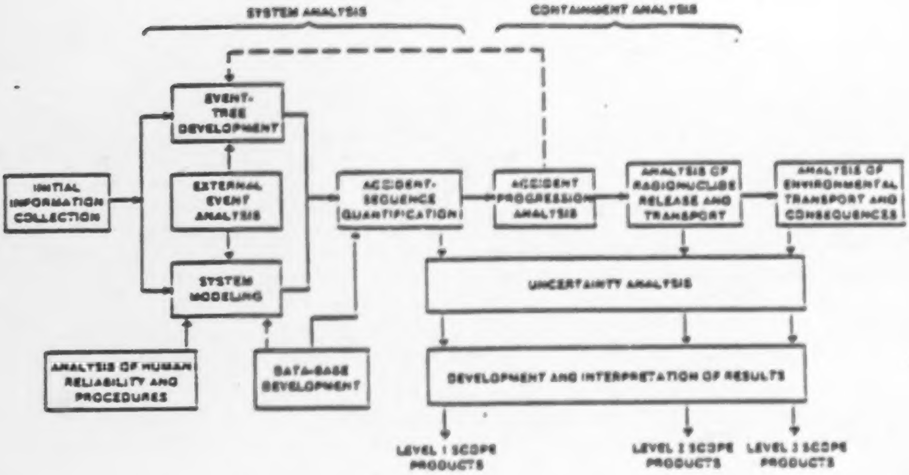
SYSTEM ANALYSIS
CONTAINMENT ANALYSIS
EVENT-TREE DEVELOPMENT
INITIAL INFORMATION COLLECTION
EXTERNAL EVENT ANALYSIS
SYSTEM MODELING
ACCIDENT-SEQUENCE QUANTIFICATION
ACCIDENT PROGRESSION ANALYSIS
ANALYSIS OF RADIONUCLIDE RELEASE AND TRANSPORT
ANALYSIS OF ENVIRONMENTAL TRANSPORT AND CONSEQUENCES
UNCERTAINTY ANALYSIS
ANALYSIS OF HUMAN RELIABILITY AND PROCEDURES
DATA-BASE DEVELOPMENT
DEVELOPMENT AND INTERPRETATION OF RESULTS
LEVEL 1 SCOPE PRODUCTS
LEVEL 2 SCOPE PRODUCTS
LEVEL 3 SCOPE PRODUCTS

Figure 3.4.1 Work Task Progression Overview for Level 3 PRA

3.5 Analysis of the Hypothetical Accident

The hypothetical accident described in the Safety Analysis Report is being reviewed and will be reanalyzed using state-of-the-art techniques with mechanistic models in current computer codes. The mechanistic treatment will include hydrogen formation by oxidation of exposed zircaloy and metallic uranium as well as fission-product-release and transport mechanisms. The treatment also will attempt to quantify fission product holdup times at each region of the N Reactor system prior to release from confinement. Hydrogen concentrations will be deter mined for each area of the confinement system as a function of time. The analyses are consistent with NRC guidance documented in NUREG-0956, "Reassessment of the Technical Bases for Estimating Source Terms". A descriptive analysis was previously completed and new best-estimate analyses will be compared with the previous work.

3.6 Hydrogen Evolution Analysis

A sensitivity study is being performed to evaluate the confinement capability to accommodate various hydrogen source rates and locations. Parallel studies are also evaluating mechanisms for hydrogen generation and the associated rates. On the basis of these studies, hydrogen monitoring and mitigation systems are being designed for installation on an expedited basis (see Section 2.5). Interaction between the ongoing PRA/severe accident modeling effort and the design/installation effort will ensure that the hydrogen monitoring and mitigation systems will provide conservative accommodation of appropriate events and considerable safety margin beyond the analyzed accidents.

3.7 Evaluation of Forms and Quantities of Iodine

The forms and quantity of iodine released from fuel under hypothesized accident conditions are important because these factors determine the amount of iodine that could eventually reach the environment.

The quantity of iodine vapor released depends on fuel temperatures, amount of fuel that experiences cladding failure, fuel configuration after cladding failure, the amount that plates out on piping and equipment surfaces and building walls, the quantity that is removed by building sprays, and the amount that is removed by filters.

The form of iodine (elemental and/or various compounds including organics) determines the effectiveness of plate-out, rain-out, and filtration.

A study will review past and current data to reevaluate the distribution and chemical forms of iodine that would be expected in the confinement volume following the postulated accident scenario. In addition, this study will provide a review of treatment methods for reducing the amount of iodine before it leaves the confinement envelope. The results of this study will be used to determine whether enhancements would be useful in increasing safety margins.

3.8 ECCS Seismic/Wind Studies

The post Chernobyl reviews of the N Reactor identified specific components and facilities related to the Emergency Core Cooling System for which there was concern regarding their ability to withstand design basis seismic and wind loadings. Analysis of their seismic and/or wind capabilities as appropriate were initiated to address these concerns. Components under evaluation include concrete block walls, emergency power batteries and related facilities, emergency diesel powered pump fuel oil supply systems, water storage facilities, portable emergency lights, reactor control room electrical panels, the fog spray system accumulator tank, high pressure air receiver tanks, and potable water tanks. These studies are scheduled to be complete by July 1987.

In the event that these studies identify areas where enhancements are appropriate, resolution activities will be identified. Completion schedules for modifications, if required, will be determined following evaluation of the impact on plant safety.

4.0 MANAGEMENT SYSTEMS AND TRAINING IMPROVEMENTS

The N Reactor SEP has initiated actions to improve management systems and training as they relate to off-normal or emergency conditions. This portion of the program has been underway for some time and will be completed by July 1, 1987.

4.1 Management Systems

The Management Systems improvements portion is being administered under three categories: Operating Procedures, Work Control Procedures, and Storage of Chemicals. Within these categories, existing N-Plant procedures and practices were evaluated against commercial nuclear plant regulatory guides and standards. The criteria or bases used in these comparisons included those developed in response to the TMI incident as formalized through Institute for Nuclear Power Operations (INPO) prorams and documents.

Management systems improvements are addressed as pre-emergency or post-emergency. From the pre-emergency perspective, existing management systems were evaluated to determine what program/procedural enhancements should be made to reduce and/or eliminate potential precursors to unusual events or emergencies. Improvements in this category deal with topics such as battery maintenance, control and storage of flammables and chemicals, Reduction of Radioactive Waste and Personnel Exposure, establishment of an Operating Experience Review program, and an expanded annual facility safety review.

Post-emergency improvements focus on the evaluation of those emergency procedures that would be used at the time of (or immediately following) plant upset, unusual event, alert, site, or general emergencies. Specific appraisal team recommendations in this category included emergency operating procedures (EOP), emergency response planning documentation, and personnel evacuation and accountability.

Implementation of these enhancements generally has entailed the augmentation or clarification of existing procedures. These procedural improvements focused on specific, clear delineations of responsibilities and lines of authority with the objective of ensuring pre-planning and documented control of the tasks covered by the procedure. The end result is assurance that off-normal evolutions will be conducted with a maximum of safety. Procedures were either developed or modified based on accepted industry standards with emphasis on applicable codes, standards, and unique N-Plant features.

In order to ensure that procedural enhancements were both comprehensive and technically appropriate, they were subjected to independent reviews by third-party technical experts.

4.2 Training

Training improvements will emphasize procedures developed or modified as part of the SEP. In addition, hands-on training/certification will be provided on new equipment as it is installed and accepted for beneficial use. The following nine items are planned for completion by July 1, 1987.

4.2.1 Remote Reactor Shutdown (See Section 2.6)

As is currently done following any plant modification or enhancement, training will be instituted for certified operators, supervisors, and managers to safely operate and monitor the remote reactor shutdown equipment. The training will focus on the newly developed procedures and on understanding the equipment applications.

4.2.2 Emergency Operating Procedures (See Section 4.1)

Retraining on these procedures will be instituted for certified staff as they are revised. As the PRAs are developed, revisions to other EOPs are possible. Training will also be conducted on these changes.

4.2.3 Certified Control Room Supervisors and Managers

Current reactor core event mitigation training is being expanded to include non-credible accident characteristics in terms of thermal hydraulics, core kinetics, and core chemical reactions. This training is specifically designed to improve skills in analyzing, diagnosing, and mitigating low-probability severe events. Useful information on PRA studies will also be included, as it becomes available, in the recertification training program.

4.2.4 Simulator Training

Exercise guides will be provided as simulator enhancements are developed for the various normal, off normal, and emergency events using new "equipment" and procedures. These guides will establish the initial simulator conditions, the learning objectives of the training, and performance standards for successful training completion.

4.2.5 Full Apparel Training

Control room personnel will be trained to perform normal and off-normal operations on the simulator while wearing self-contained breathing air apparatus and/or other protective apparel. Exercise guides, similar to those in 4.2.4 above, will be developed and used.

4.2.6 Graphite Oxidation Considerations

Training on material that provides understanding of the processes of graphite oxidation, the conditions that can affect oxidation, and the N Reactor design conditions that preclude graphite oxidation will be provided.

4.2.7 Shift Manager Emergency Duties

In accordance with normal practice, the shift managers will receive special training on all modified procedures and on equipment that is new or modified. This training will focus on their responsibilities and duties as Area Emergency Directors.

4.2.8 Refueling Supervision Qualification

Supervisors in charge of refueling operations will be given a formal qualification training covering all charge/discharge fuel handling operations. Certification of all such staff members is required.

4.2.9 INPO Certification

The N Reactor technical training programs, developed to the same standards as those used at commercial facilities, will be submitted to Institute for Nuclear Power Operations (INPO) for certification as meeting "INPO Accreditation Criteria." Training programs that will be submitted for accreditation include those for:

- Certified Control Room Supervisor
- Certified Reactor Operator
- Radiation Protection Technician
- Chemistry Technician
- Non-Certified Operator
- Maintenance Crafts
- Technical Support Staff

5.0 CONCLUSION

DOE is committed to not only achieving an acceptable level of safety, but also to pursuing safety excellence at N Reactor. To this end, DOE has initiated an aggressive, responsive Safety Enhancement Program to further increase the margin of safety at N Reactor. The highly unusual Chernobyl accident provided the impetus for DOE to accelerate its safety reviews and to accelerate implemention of enhancements to the safety of N Reactor; however, the Safety Enhancement Program is part of a continuing process fostered by DOE's commitment to protect the health and safety of the public.

The Safety Enhancement Program will provide for plant modifications at N Reactor resulting in a lower probability of severe accidents. Technical studies and evaluations will be performed to provide added assurance that an adequate margin of safety is being maintained. This program will also provide for improved management systems and training for the operators of N Reactor.

APPENDIX

DEFINITIONS

The following acronyms are defined in alphabetical order.

ACRS	Advisory Committee on Reactor Safeguards
ASEH	Assistant Secretary for Environment, Safety and Health
ASTM	American Society for Testing and Materials
DOE	Department of Energy
ECC	Emergency Control Center
ECCS	Emergency Core Cooling System
EOP	Emergency Operating Procedures
EPRI	Electric Power Research Institute
EQP	Equipment Qualification Program
GAO	Government Accounting Office
HFIR	High Flux Isotope Reactor
IEEE	Institute of Electrical and Electronic Engineers
INPO	Institute for Nuclear Power Operations
LERF	Liquid Effluent Retention Facility
MWt	Megawatts thermal
NAE	National Academy of Engineering
NAS	National Academy of Sciences
NDE	Non-Destructive Examinations
NRC	Nuclear Regulatory Commission
NUSAR	N Reactor Updated Safety Analysis Report
OSC	Operational Support Center
PRA	Probabilistic Risk Assessment
psig	pounds per square inch gauge
SEP	Safety Enhancement Program
Supply System	Washington Public Power Supply System
TMI	Three Mile Island
TSC	Technical Support Center